ELECTRICAL WORLD

A McGRAW-HILL PUBLICATION

Philip Sporn Plant

Large-scale generation with economy of fuel, operation, maintenance, investment

Capitalize on this One Piece Construction

...and get *More*

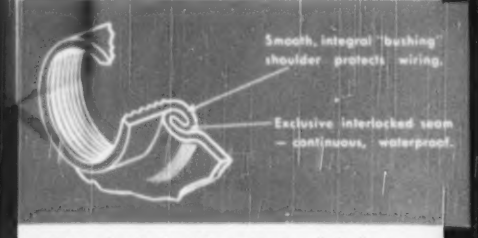
STRENGTH · STAMINA · ENDURANCE

Yes, you can capitalize on this new preassembled yard pole combination—in more ways than one!

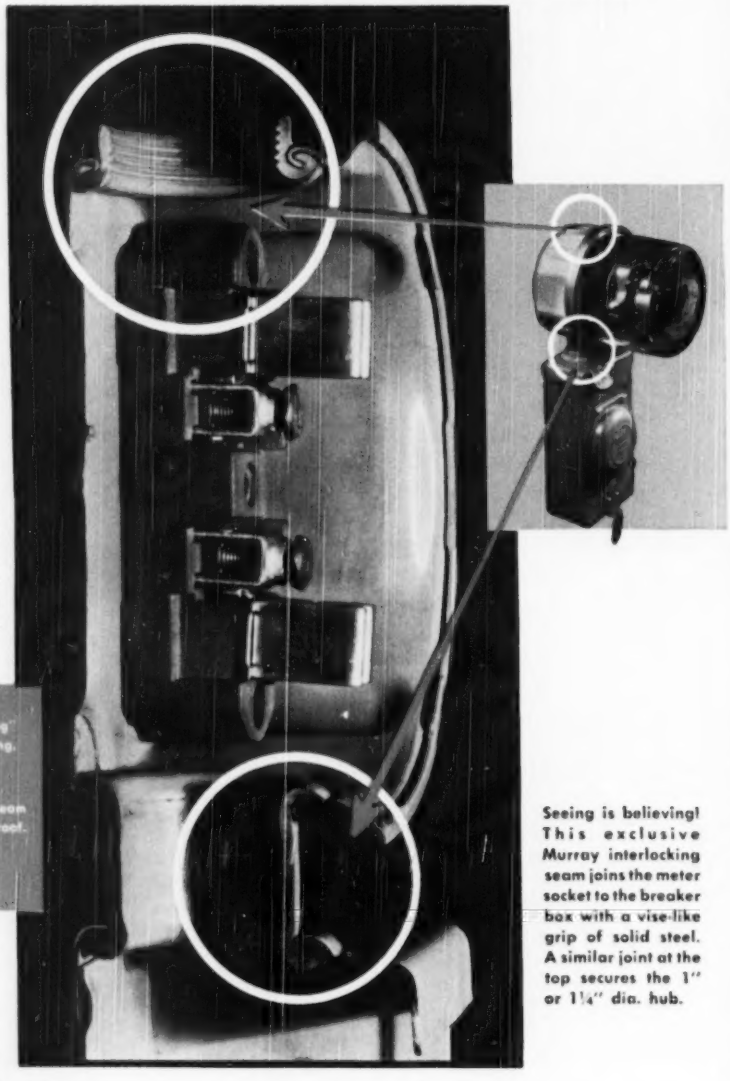
You not only save the cost and trouble of assembly, but you get a stronger, tougher, longer-lasting unit as well. To be specific: Test men screwed a ten-foot length of conduit into the upper hub — banged the combination around...twisted it... wrenched it back and forth. Still it remained solid...still the hubs stayed water-tight!

As the enlarged photo reveals, steel clasps steel in an interlocking grip that defies destruction. The result is a tough, rugged, all-steel unit that takes terrific punishment — and still stays water-tight!

This improved Murray preassembled meter socket and yard pole combination provides the unsurpassed protection of Murray *fully magnetic* circuit breakers. Approved by R.E.A.; listed by Underwriters' Laboratories. Construction is completely of steel, weatherproofed by zinc coating and baked-on melamine finish. Write for complete specifications.



Take a close look at this precision interlocked seam, used in three places in the new Murray preassembled yard pole combination. Rigid...rugged... waterproof—the hubs *can't* loosen up, *can't* break off. Made of tough, dependable steel throughout.



Seeing is believing! This exclusive Murray interlocking seam joins the meter socket to the breaker box with a vise-like grip of solid steel. A similar joint at the top secures the 1" or 1¼" dia. hub.

Murray MANUFACTURING CORPORATION

1250 ATLANTIC AVENUE • BROOKLYN 16, N. Y.

Electrical Safety Devices for Home and Industry

OF PERSONAL INTEREST

EEI Convention

Every one of us who has a stake in the electric utility industry would like to take in the EEI's Atlantic City convention. Unfortunately, we can't all make it. For those who must stay home and keep things humming, **Electrical World** puts together a conscientious report which includes digests of major talks, and a summary of all that was accomplished at the industry's most important meeting. Even if you can't see the sights and listen to the speeches, you can get the gist of what happened in the next engineering issue of **Electrical World.**

Lindseth

Speakers this year will include:

EEI President Elmer L. Lindseth, Curtis E. Calder of Ebasco, Ralph J. Cordiner of GE, James E. McCarthy who is Dean of the College of Commerce at Notre Dame, W. C. Mullendore of Southern California Edison, W. E. Knox of Westinghouse International, Charles E. Oakes of Pennsylvania Power and Light, W. E. Wood of Virginia Electric and Power, Fred. A. Compton of Detroit Edison, Kent Leavitt of The National Association of Soil Conservation Districts, H. W. Voorhees of the New Jersey Farm Bureau, George H. Love of Pittsburgh Consolidation Coal Co, Walter Geist of Allis-Chalmers, and G. W. Evans of Kansas Gas and Electric Co.

These men, as you know, all hold positions of top responsibility.

President Lindseth, from his countless contacts with business leaders in all fields, will discuss the state of the industry.

What the others have to say will cover the course of the industry's most urgent problems. Professor McCarthy, of Notre Dame, for instance, will discuss free enterprise—and how it is endangered by those who would have us believe that America is composed of groups with diametrically opposed interests. We are all dependent upon each other, and free enterprise is our greatest force for unity.

In brief, the subjects of greatest concern to all of us are thoroughly investigated by the men best qualified. We'll give you a careful report, in the June 19 issue of **Electrical World.**

THE EDITORS

ELECTRICAL WORLD

Published for 76 years for those engaged in the business of generating, transmitting, distributing or applying electric power

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...for proved security in underground circuits

It makes no difference what type of ground you bury Hazard Armortite Cable in. For, although it is low in cost, light in weight and requires no expensive ducts, Armortite has built-in protection for long life in any type of location.

Moisture-proof Hazard Watertite Submarine insulation safeguards the conductors electrically... Okobestoprene Tape over the insulation (instead of braid) makes a tight seal, which prevents wicking-in of moisture, protects against chemical action and assures permanent circuit identification. Finally, tough leather-like Armortite tapes, a special plastic sealing compound and saturated jute coverings give additional protection against moisture, mechanical damage and other potential enemies of cable that is buried direct in the soil. Extremely high impact resistance is one of the outstanding characteristics of Hazard Armortite Cable.

Armortite Cable has been setting records for long, trouble-free service for over twenty years. This specially developed underground cable is also extremely easy to handle, splice and terminate, offering important installation economies. Consider all the money-saving features of Armortite before you install underground circuits. For complete information, write to Hazard Insulated Wire Works, Division of The Okonite Company, Wilkes-Barre, Pa.

RECOMMENDED FOR:

AIRPORT LIGHTING • OPEN AIR THEATRE LIGHTING
STREET LIGHTING • ATHLETIC FIELD LIGHTING
HIGHWAY LIGHTING • POWER FEEDERS BETWEEN BUILDINGS

HAZARD

8233

TIGHT JOINTS

AT ALL POINTS . . . "VIA GRAYBAR"

Reliable Connectors, Splices

Graybar can supply everything your linemen need for connecting all types of lines *securely*. Two of the high-quality Reliable items we distribute are: (1) Solderless connectors—accurately cold headed. All parts are at least 98% copper, have no sharp corners, and have torque, compression, and reuse factors far above ordinary connectors. (2) Automatic splices and deadends for copper, ACSR, or steel strand—now filled with non-corrosive grease and packed to stay in perfect condition.

O-B INSULATORS

In these days of overloaded distribution systems, no line is stronger than its insulators. Graybar supplies superior-quality Ohio Brass insulators in strain, pin, and suspension types.

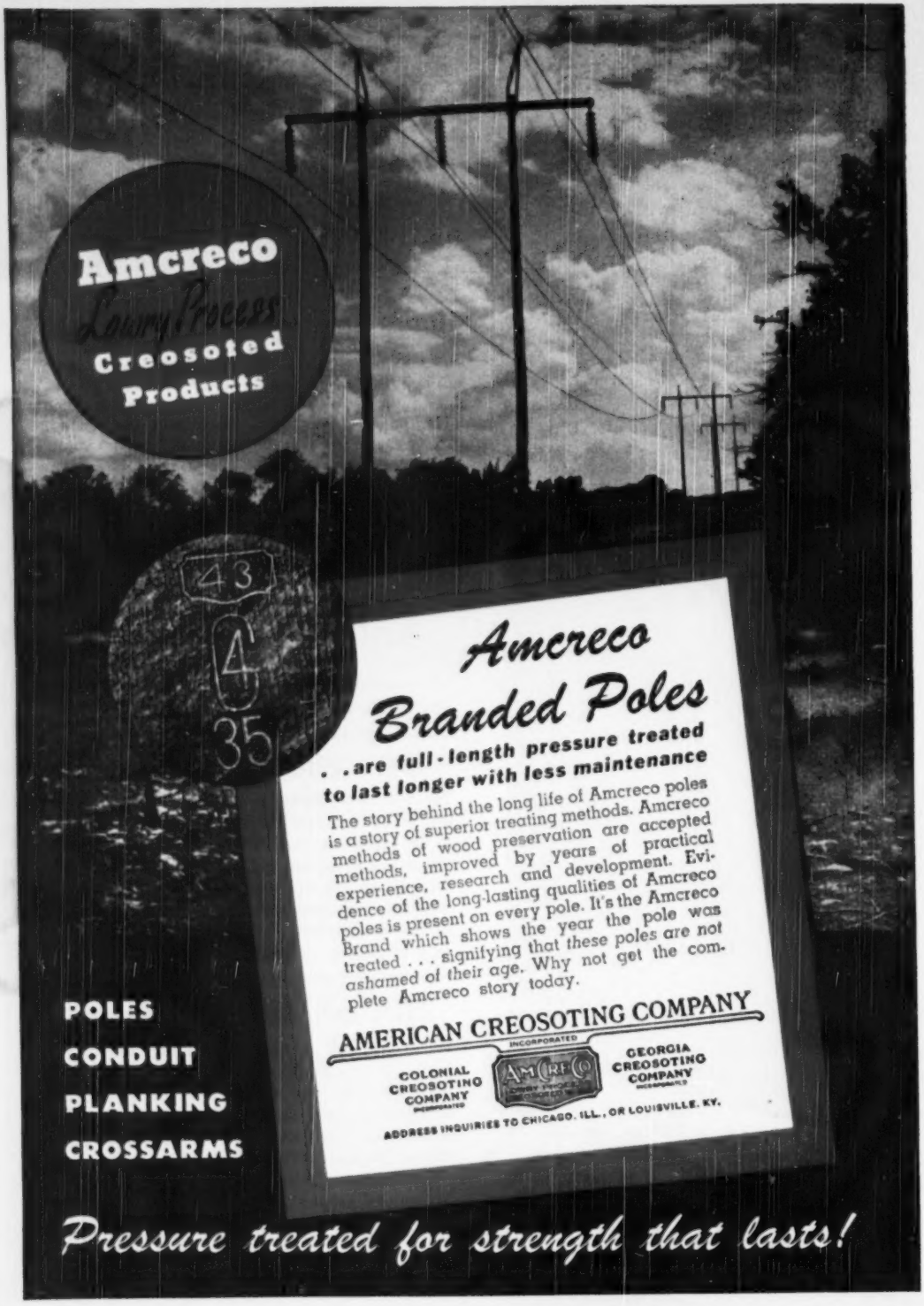
ONE SOURCE FOR ALL

For both transmission and distribution lines, Graybar has everything "from the bottom of the hole to the top of the pole"! By ordering all your pole-line needs from this single source, you save time and paper-work expense. You get the leading lines of poles, crossarms, insulators, hardware, strand, line trucks and tools. And you get them the quickest way possible — delivered wherever you specify.

Men who know your needs

When you call on Graybar, for supplies or for information, you can expect us to meet your needs both promptly and accurately. That's because Graybar has been familiar with your needs ever since the first lines went up. You're welcome to the help of the near-by Graybar Outside Construction Specialist in planning any pole-line or underground project. *Graybar Electric Company, Inc. Executive offices: Graybar Building, New York 17, N. Y.* 5018

IN OVER 100 PRINCIPAL CITIES


Amcreco
Lowry Process
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Branded Poles
. . are full-length pressure treated
to last longer with less maintenance
The story behind the long life of Amcreco poles is a story of superior treating methods. Amcreco methods of wood preservation are accepted methods, improved by years of practical experience, research and development. Evidence of the long-lasting qualities of Amcreco poles is present on every pole. It's the Amcreco Brand which shows the year the pole was treated . . . signifying that these poles are not ashamed of their age. Why not get the complete Amcreco story today.
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POLES
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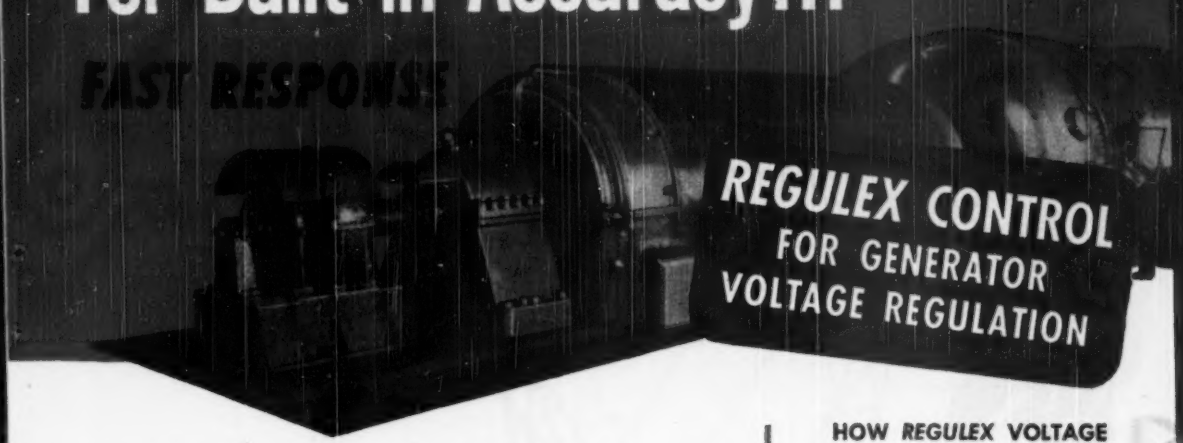
Pressure treated for strength that lasts!

For Built-in Accuracy...



A SMALL *REGULEX* GENERATOR, rated only 5 kw, holds constant output voltage on this huge 115,000 kw Allis-Chalmers steam turbine generator unit. In addition to regulating voltage, *Regulex* control eliminates the pilot exciter on large generators — supplies full excitation on smaller machines.

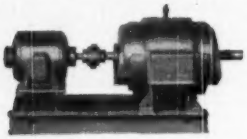
The *Regulex* generator is a d-c machine with a control field. A minute change in current to this control field will produce a large change in output voltage. This characteristic provides a rotating regulator that controls the output of large generators.

Regulex voltage regulation assures accurate, constant voltage output on synchronous generators and condensers.

Check these advantages:

1. Performance characteristics can be depended upon because they are built-in . . . not the result of fine adjustment.
2. No special training of maintenance personnel is required because construction is similar to a standard exciter.
3. Outages are reduced by eliminating wearing parts, simplifying controls.
4. Regulator action is practically instantaneous, assuring good power system stability over a wider range of system fault conditions.
5. Voltage control is smooth and reliable.
6. Large amplification improves response by strong field forcing.

AS A VOLTAGE REGULATOR, *REGULEX* CONTROL HAS TWO PARTS



1. Regulex Exciter — supplied as a motor-generator set. It is similar in design and appearance to a conventional exciter, mounted on a common base with a standard induction motor drive. Design is compact — simplifying installation and circuit connections.

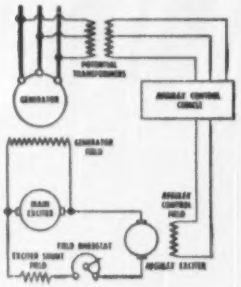
2. Regulex Control Cubicle

— a metal enclosure that houses the control circuit components, none of which have moving parts, require maintenance.

Regulex and *Synchro-Operator* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

HOW *REGULEX* VOLTAGE CONTROL WORKS



Potential transformers energized from generator terminals feed a-c line voltage into the *Regulex* control cubicle where the discriminator circuits convert and amplify this voltage to a d-c signal of correct magnitude and polarity. This signal is then applied to the *Regulex* exciter control field. It is further amplified by the *Regulex* exciter to maintain correct excitation for constant generator terminal voltage.

Normal installations employ a standard self excited main exciter, the shunt field of which is connected in series with the *Regulex* armature. The *Regulex* armature output voltage adds or subtracts from the main exciter field voltage as required to maintain generator excitation. This arrangement gives immediate, strong exciter and generator field forcing when variations in generator terminal voltage occur. This connection also assures continuity of main exciter excitation under all conditions.

To determine how *Regulex* control can be applied for voltage regulation on your job, call your nearby A-C representative or write direct. A-3088

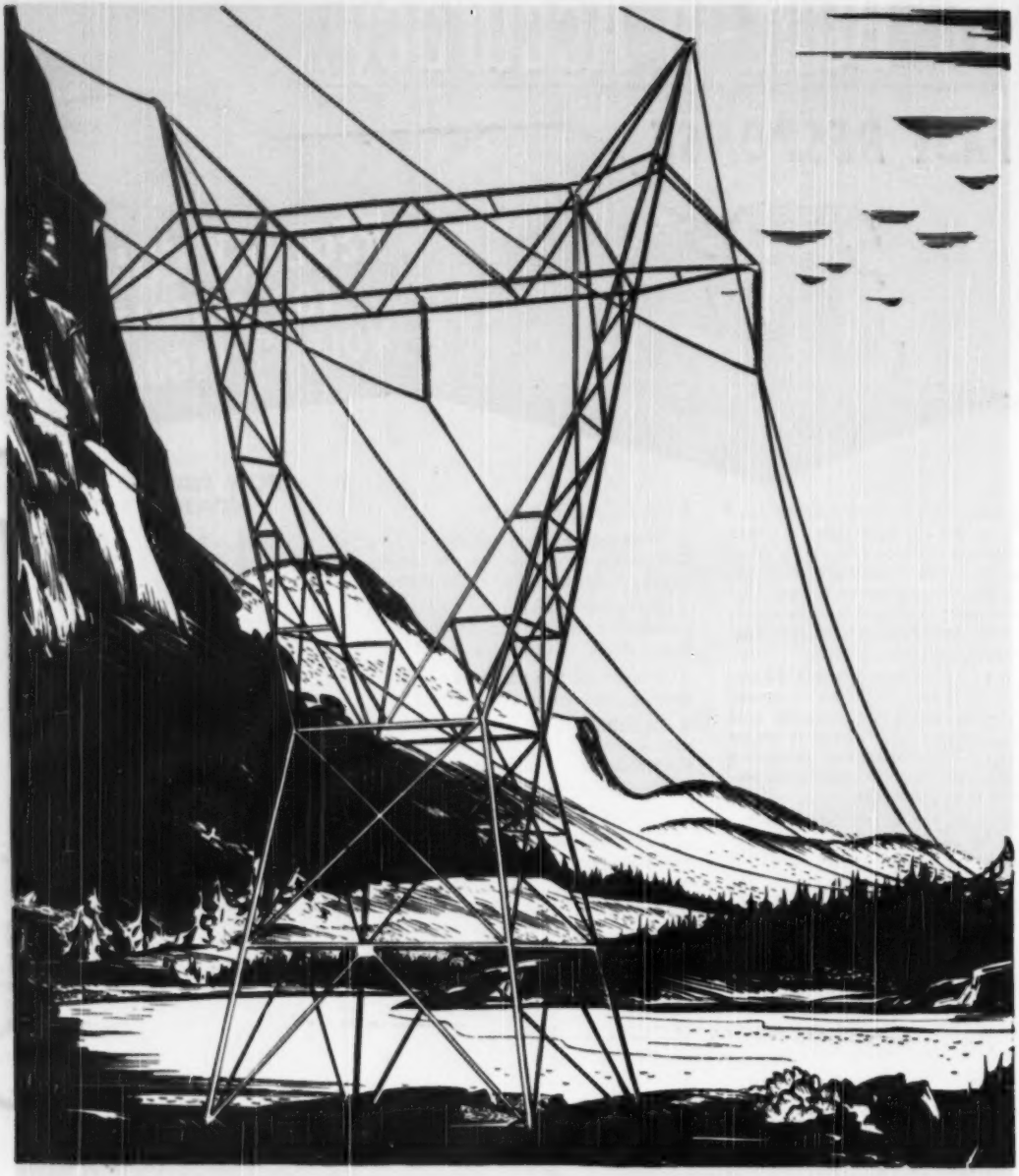
ALLIS-CHALMERS, 932A SO. 70 ST. MILWAUKEE, WIS.

Other Allis-Chalmers Control Devices

SYNCHRO-OPERATOR — Automatically synchronizes alternating current generators, tie lines, synchronous condensers, etc.

D.C. POSITIONER — Operates from power plant d-c bus, used for remote indication, control, order telegraph, etc.

ROCKING CONTACT REGULATORS — These dependable units are used where features of mechanical type regulators are desired.



ALCOA

FIRST IN ALUMINUM

Unfinished business

In developing ACSR, "unfinished business" is good. Part of ours concerns ultra-high voltage transmission, pointing toward the day when it may be necessary to transport bigger blocks of electrical energy.

Delivering power at those voltages may demand bigger conductors than have ever been used commercially. And bigger conductors introduce new problems of installation. Alcoa has been working on this particular unfinished business for 30 years, anticipating the day when power companies will operate lines at voltages never before commercially practical.

Problems of the future or problems of today—we want to help with both. We've been helping with them since 1888. ALUMINUM COMPANY OF AMERICA, 1924F Gulf Building, Pittsburgh 19, Pennsylvania.

TYPICAL: Alcoa supplied approximately five miles of "expanded ACSR" in two sizes for the Tidd 500-kv Test Project sponsored by American Gas and Electric Service Corporation at Brilliant, Ohio. Smaller of the two cables is 1.65 inches; the larger, two inches in diameter.

Jointing compressor in operation on 2-inch diameter "expanded ACSR".

ALCOA ®

FIRST IN A·C·S·R

WIRING NEWS

Hint for power salesmen

Practical tip for installation, maintenance, and operation personnel

A PERIODICAL DIGEST OF WIRING IDEAS FROM THE GENERAL ELECTRIC CONSTRUCTION MATERIALS DEPARTMENT

Enlarged section of special, untreated cotton cloth used in the manufacture of G-E No. 1799 varnished-cambric insulation. Note large holes that assure maximum varnish absorption needed for top insulating efficiency.

Quality Insulation Begins with the Cloth!

That's right, in the manufacture of General Electric No. 1799 varnished-cambric insulation, only a selected, untreated cotton cloth is used. Woven to exacting General Electric standards, it absorbs and retains a greater amount of our own tough, flexible varnish than ordinary cloth. The result — after carefully controlled baking processes — is an insulation high in dielectric strength, stubbornly resistant to extremes of operating temperature, and uniform in thickness and strength.

Even though subjected to continued high conductor temperatures, General Electric varnished-cambric remains completely pliable.

In one test, a cable insulated with No. 1799 varnished-cambric, after more than 400 hours in an oven at 125 C, was bent around a ½" diameter mandrel without damage to the insulation.

G-E varnished-cambric cables are available in three basic types:

BRAIDED — for power and control circuits, exposed or installed in conduit in dry locations; and for transformer and apparatus power leads.

INTERLOCKED-ARMOR — for overhead distribution in power plants and factories. This cable requires no raceways, permits speedy installations.

LEADED — for generator leads and power wiring in conduit or in underground ducts.

For information on any type in the complete line of G-E varnished-cambric cables, check box (A) in coupon.

Four G-E Products Improve Plant and Residential Wiring Systems

New Switch Box Has Five Big Features

Featuring a redesigned side-plate locking arrangement, this new General Electric switch box simplifies both the installation and ganging of boxes on any job.

New side-plate wedging action locks side-plates securely in position. Box sides cannot be dislodged by hammer blows while the box is being mounted or during scribing for lath cut-outs.

In addition to side-plate nail holes for easy gang mounting, a set of nail-through holes allows speedy mounting of *entire box* direct to studding. Merely drive home two 10d nails and you're ready to wire. There's no disassembly of side sections . . . no interference with knockouts . . . no clearance problems on any standard device.

Four contact points instead of three eliminate rocking or tilting of box during installation. Special side pry-outs provide for out-of-the-ordinary installations. All pry-outs are easily removable with a simple twist of a screwdriver blade.

A new single-screw ear for faster adjustments provides an added feature. A heavier bridge across ears gives increased support.

The new General Electric switch boxes are easily gangable and may be used with old type boxes on new construction or on modernization jobs. Get complete information on *all* their time-saving features—just check box (B) in coupon.

G-E Devices Keep Pace With Increased Loads

General Electric offers you up-to-the-minute wiring devices for circuits that supply current to motors, appliances, and motor-driven tools.

Heavy-Duty Switches

Smooth, reliable control of 125- or 250-volt circuits presents no problems when you use the new General Electric heavy-duty switch. Designed for 20- and 30-ampere operation, these T-rated, specification-grade units offer new improvements for faster, easier installations.

The switch is completely enclosed in a plastic housing for total protection from foreign particles during installation operations and is of shallow construction to provide ample wiring space in standard switch boxes.

Back-wired pressure terminals on the switch eliminate necessity of looping wires. Wires go in straight and are held firmly in place by pressure connectors.

For further information on General Electric's complete line of long-lived, heavy-duty switches, check box (D).

New Grounding Outlets

New grounding outlets and plugs meet the need for devices to conform to NEC or other applicable codes requiring grounding of portable electrical equipment. The outlet will accommodate any two-prong standard parallel-blade plug cap and will also take the special three-pole grounding cap. It is back-wired for easy installation and has two grounding terminals so that ground wires may be carried easily from one outlet to another. Pressure terminals accommodate two wires for easy wiring. In addition, ground contacts are also connected to washer-type plaster ears. Check box (C) for further information.

Quick-change Fuses

You'll find General Electric time-delay fuses are real time savers. Available in both ferrule and knife-blade types, they are easily renewable. Simply unscrew cap . . . insert new, self-aligning link . . . and replace cap. G-E time-delay fuses give quick positive protection against dangerous overloads — yet limited transient overloads won't cause unnecessary "blows". Check box (E) for information.

Section K10-627

Construction Materials Department, General Electric Company, Bridgeport 2, Connecticut

- ☐ A—Varnished-cambric Cables
- ☐ B—New Switch Box
- ☐ C—New Grounding Outlet
- ☐ D—Heavy-duty Switches
- ☐ E—Time-delay Fuses

Name _____ Title _____

Company _____

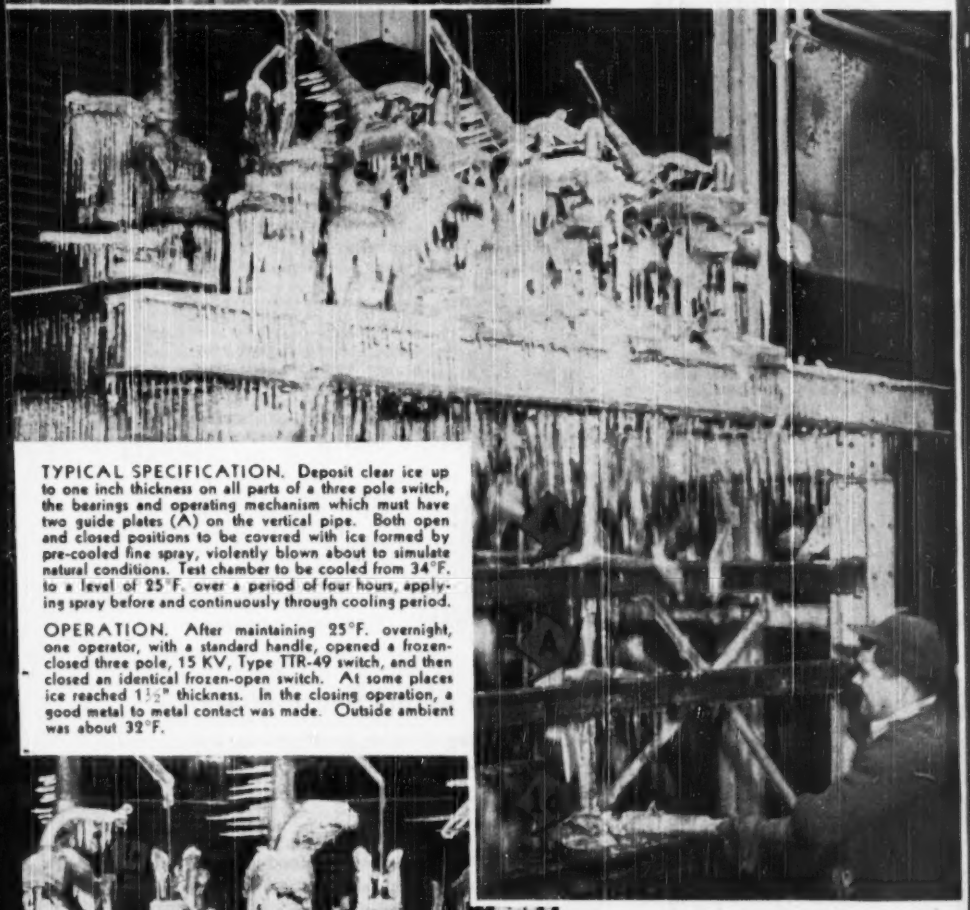
Address _____

City _____ Zone _____ State _____

GENERAL ELECTRIC

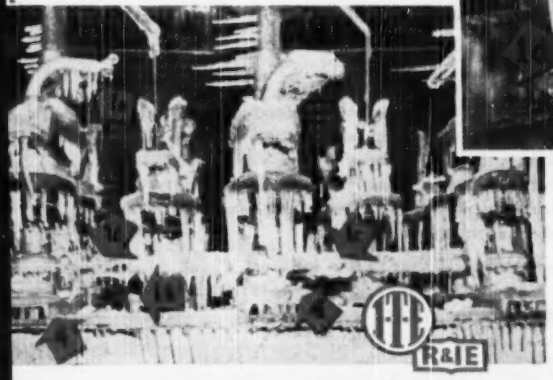
an R&IE customer

CHECKS the FACTS on ICE LOADING by witness test



TYPICAL SPECIFICATION. Deposit clear ice up to one inch thickness on all parts of a three pole switch, the bearings and operating mechanism which must have two guide plates (A) on the vertical pipe. Both open and closed positions to be covered with ice formed by pre-cooled fine spray, violently blown about to simulate natural conditions. Test chamber to be cooled from 34°F. to a level of 25°F. over a period of four hours, applying spray before and continuously through cooling period.

OPERATION. After maintaining 25°F. overnight, one operator, with a standard handle, opened a frozen-closed three pole, 15 KV, Type TTR-49 switch, and then closed an identical frozen-open switch. At some places ice reached 1½" thickness. In the closing operation, a good metal to metal contact was made. Outside ambient was about 32°F.



REQUIREMENTS MET. Both switches operated to full open and closed position. R&IE switch design anticipated the problem, and here's why. (1) Generous proportion of clearance areas, — *a* – blade crank and frame, *b* – insulator crank and base; 2 – Minimum ice to shear; 3 – No parts in compression; 4 – Sealed bearings; 5 – Maximum operating leverage; 6 – Hi-Pressure blade rotating contacts; 7 – No exposed hinge pins; and, 8 – Sealed Pressure Contact Hinge. Maximum effort applied to cranks (1a), (1b), clevis joints (1c), bearing (4) and handle plate (1d).

RAILWAY and INDUSTRIAL ENGINEERING CO., GREENSBURG, PA.
AFFILIATED WITH THE I-T-E CIRCUIT BREAKER CO., PHILADELPHIA, PA.
IN CANADA – EASTERN POWER DEVICES LIMITED, TORONTO

UPPORTS, FITTINGS

SWITCHES OUTDOOR

SWITCHES

INTERRUPTER SWITCHES

CUTOUTS AND THERMO-RUPTERS

DISTRIBUTION EQUIPMENT

SWITCH OPERATING MECHANISMS

SUBSTATIONS

OPEN OR ENCLOSED, ISOLATED PHASE HEAVY DUTY BUSES

KIRK INTERLOCK SYSTEMS

AUTOMATIC RECLOSING EQUIPMENT

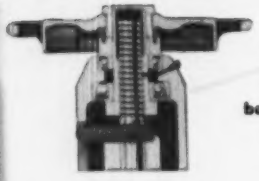
METAL CUBICLES

TESTING DEVICES

You get all these features in

THESE WERE EDWARD FIRSTS!

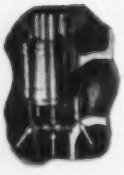
IMPACTOR* HANDWHEEL
Maximum closing torque in minimum space. An all time high in valve design.



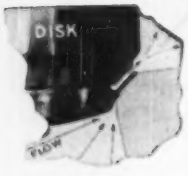
EVALTHRUST* YOKE BUSHING Patented ball bearing construction for easy valve operation.

CLOSURE INDICATORS
No guessing if valve is tightly closed for either regular operation or for special tests.

LOW PRESSURE-LOSS BODY CONTOURS
Both globe and angle bodies let maximum flow through. Pioneered by Edward. Copied but never bettered.



THREE-POINT GUIDING
Streamlined, cored out guide ribs, integral with body, keeps disk in alignment. Dangerous stem guiding eliminated.

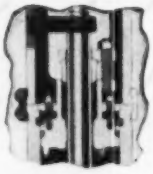


SELF-CENTERING DISK THROTTLING LIP
Avoids jamming or cocking, assures tight seating, prevents wire-drawing.

*Registered trade names of Edward Valves, Inc.

FREE FLOATING TUBULAR DISK-PISTON
Quicker opening, surer closing, flow tested for less pressure loss.

EQUALIZER
Original design. Gives higher, surer piston lift, lowers pressure loss, eliminates wear-producing vibration.



EDWARD PRESSURE-SEAL DESIGN First pressure-seal non-return valves were built by Edward. Pressure-sealing parts do not guide floating disk-piston, insuring a permanent seal.

INTEX* INTEGRAL SEATS
Hard facing applied directly to valve body completely eliminates possibility of leaks behind screwed or welded-in seat rings.

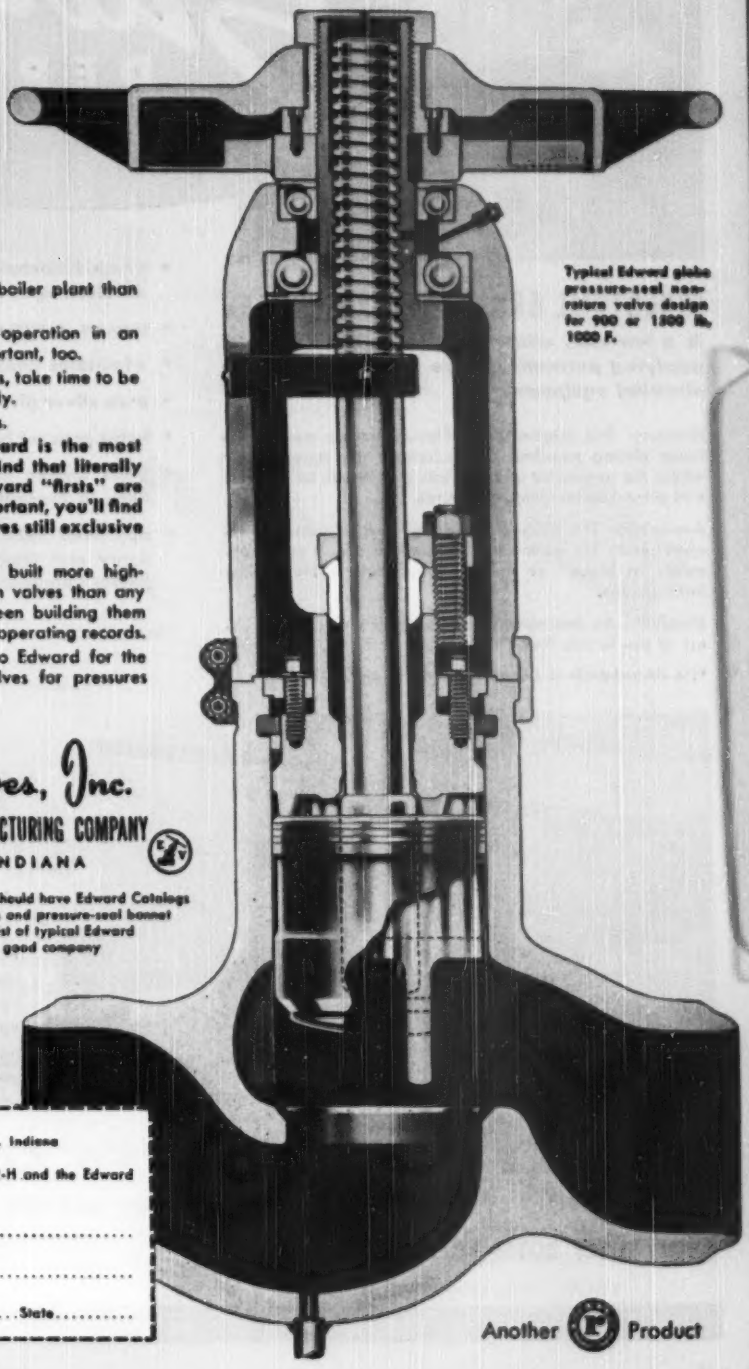
These are also Edward Firsts!

Evalized* plating of valve parts for wear and corrosion resistance . . . Patented welded-bonnet Univalves* . . . Impactor* handles for small valves . . . Seat located guide ribs in gate valves . . . No-bonnet instrument valve construction . . . Intex* Stellited welded-in seats . . . Hour-glass type disk-piston . . . EValpak* packing . . . Separated feedline stop-check valves . . . Screwed and welded flanges for forged steel valves . . . Swing bolt retaining washer construction, and

***Patented Interchangeability of Stop, Check and Non-Return Valves . . .* Greatest possible valve flexibility for your plant!**

Edward Non-Return Valves

DON'T SETTLE FOR LESS!



Typical Edward globe pressure-seal non-return valve design for 900 or 1500 lb, 1000 F.

No valve is more important in your boiler plant than your non-return valve.

From it, you expect quick, sure operation in an emergency. Low pressure loss is important, too.

Next time you buy non-return valves, take time to be sure. Go into design features carefully.

Also, look at actual service records.

If you do, you'll find that Edward is the most copied valve in the field. You'll find that literally dozens of features that were Edward "firsts" are now industry standards. More important, you'll find there are still many patented features still exclusive with Edward.

You'll also find that Edward has built more high-pressure high-temperature non-return valves than any other manufacturer . . . and has been building them for more years, piling up unmatched operating records.

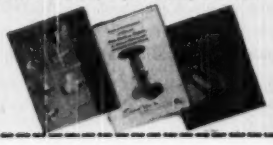
Don't discount experience. Look to Edward for the best and the first in non-return valves for pressures from 150 to 2500 lb sp.

Edward Valves, Inc.

Subsidiary of **ROCKWELL MANUFACTURING COMPANY**

EAST CHICAGO, INDIANA

ASK FOR THESE CATALOGS • You should have Edward Catalogs 12-B and 12-H, covering non-return valves and pressure-seal bonnet valves in your file. Also, we'll send you a list of typical Edward non-return valve installations to show what good company you'll be keeping if you specify Edward.



Edward Valves, Inc.
1350 West 145th Street, East Chicago, Indiana

Please send me Catalogs 12-B and 12-H and the Edward non-return valve installation list.

Name.....

Street.....

City.....Zone....State.....

Another Product

Silver DEPOSITS

INDUSTRIAL BRUSH ELECTRO-PLATING

Is a low-cost, efficient and practical method of applying permanent pure silver* deposits on electrical equipment.

Economy: This original Brush Plating process applies the finest plating possible. Electrodeposits are applied only where the applicator is used. Plating costs can be reduced and placed under complete control.

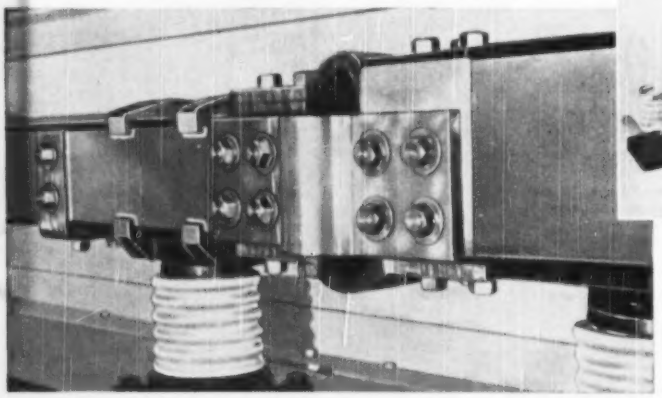
Availability: The efficient power unit and solutions are always ready for instant use — anywhere. Use it on equipment "in place" or during manufacture — No service interruptions.

Simplicity: An average worker will learn the correct method of use in less than thirty minutes.

*The electrodeposits of this process are 99.9% plus, pure silver.

- **Brush Electroplating permits rehabilitation of obsolete equipment**
- **insures positive protection to strategic metals**
- **eliminates destructive oxidation**
- **pure silver gives greater electrical conductivity**
- **helps prevent loss of power**
- **gives longer and more satisfactory performance to present electrical equipment**
- **approved and used extensively by United States Army and Navy — Industrial plants and most Power Companies**

*Also applicable for other metals, etc.



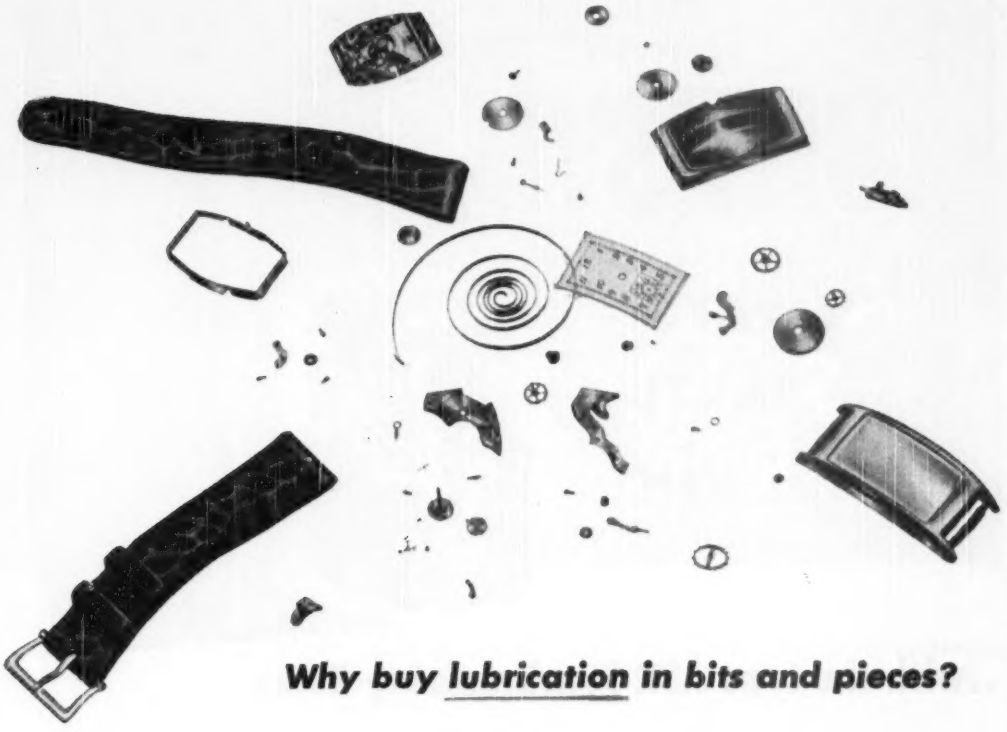
NEW LOW group price for complete outfit ready for use as illustrated, only $215.00, f.o.b. Chicago. Brushes are made of Nylon bristles and are unaffected by normal plating solutions. The above installation is all you need for this modern electroplating process.

AJAX-CONSOLIDATED COMPANY

Service to Utilities . . . Industry and Railroads

4621 WEST 20TH STREET • • • • • CHICAGO 50, ILLINOIS

YOU WOULDN'T BUY A WATCH THIS WAY...



Why buy lubrication in bits and pieces?

Correct Lubrication is a lot more than just drops of oil and dabs of grease.

It's knowledge of your machines and their exact lubrication needs. It's the *right* lubricant, applied the *right* way. It's engineering service that helps you create one unified lubrication program throughout your plant.

With Socony-Vacuum, you get...

1. A study of all your machine lubrication requirements.
2. Recommendations of the right lubricants.
3. Engineering counsel on special problems.
4. Help on reclamation, storage, handling of lubricants.
5. Continued cooperation with Plant Personnel.
6. Reports on progress and results.

Call your Socony-Vacuum Representative *today!* Get this program started in *your* plant...to assure more continuous production, lower maintenance costs.

SOCONY-VACUUM

GARGOYLE Lubricants

SOCONY-VACUUM

Correct Lubrication

WORLD'S GREATEST LUBRICATION KNOWLEDGE AND ENGINEERING SERVICE

SOCONY-VACUUM OIL COMPANY, INC., and Affiliates: MAGNOLIA PETROLEUM COMPANY, GENERAL PETROLEUM CORPORATION

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

..with the type ASR Synchronizing Relay

Getting the motor started right every time—and providing complete protection at all times—are the basic functions of the new Westinghouse SLIPSYN Synchronous Motor Control.

Heart of the new SLIPSYN is the amazing Type ASR synchronizing relay. Characterized by its extremely simple, sturdy and reliable design, this new relay is especially suited for heavy industrial service.

The ASR not only applies the field at the proper speed, but also at a favorable rotor position for best synchronizing performance. It is easily adjusted on the job for best operating conditions under actual load.

**Trade Mark*

SLIPSYN is the name applied to the complete line of Westinghouse Synchronous Motor Control. Standard types are available for operating and protecting all types of synchronous motor drives. Find out all the advantages of SLIPSYN controls now. Call your nearest Westinghouse office or write for Booklet B-4379. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa.

J-21588

Westinghouse
SLIPSYN
SYNCHRONOUS MOTOR CONTROL

Cut Cost

...IN THE PLANNING STAGE--

Specify SIMPLEX-ANHYDROPRENE CABLES

When planning transmission and distribution systems for installation in conduit, in underground ducts, or in open air raceways in buildings, you'll take a big step toward low-cost operation by specifying Simplex-Anhydroprene Cables. ... Their simple construction, stable electrical and physical properties, and versatility provide many advantages profitably realized in low purchase cost, low installation and maintenance costs and long service life. ...Some of these cost-cutters are included in the checklist below. But even they are only a few of many available to you when you install Anhydroprene Cables. For the complete Anhydroprene story, plus specification data, drop us a card today for Bulletin 115. (Fill out and mail the coupon below.)

- Light Weight
- Small Diameter
- No Braids to Rot
- Flexibility at Low Temperatures
- Abrasion Resistance
- Low Water Absorption
- Protection against Oils, Heat, Sunlight and Flame
- Resistance to Acids, Alkalies and Corrosive Chemicals
- Easy Jointing and Tapping
- Elimination of Duct Lubricants
- No Potheads Needed at Terminations

Simplex-Anhydroprene Cables are recommended for plant and shop wiring, for instrument wiring, for use as underground primaries and secondaries, transformer leads and pole line risers, and in signal and control circuits.

SIMPLEX
WIRE & CABLE CO.
79 Sidney St., Cambridge 39, Mass.

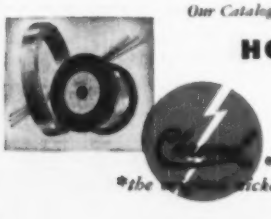
SIMPLEX WIRE & CABLE CO.
79 SIDNEY ST., CAMBRIDGE 39, MASS.
GENTLEMEN: PLEASE SEND BULLETIN 115 TO
NAME_____ TITLE_____
FIRM_____
STREET_____
CITY_____ STATE_____

When you think of Electric Heat

think of Hoskins Chromel*

Take a good look inside almost any electric furnace and you'll see the good and glowing reason behind your growing industrial heating load. Durable heating units made of Hoskins Chromel resistance alloy. Durable Chromel heating units that have consistently backed up your power sales efforts with dependable, trouble-free, long-life performance on countless different applications. For Chromel, you know, is the *original* nickel-chromium alloy that *first* made electrical heating practical. It's highly resistant to oxidation because, in use, it quickly forms a thin, dense oxide "skin" that doesn't readily flake off with the expansion and contraction caused by intermittent heating and cooling. Instead, this tight protective coating adheres strongly to the basic metal and effectively prevents continued destructive oxidation. In addition to its extreme durability, Chromel possesses excellent electrical resistance characteristics, too. It maintains close-to-constant "hot" resistance between 700° and 2000° F., delivers full rated power throughout its long and useful life. These are the good basic reasons why Hoskins Chromel has been used consistently and with complete confidence for over 40 years by nearly every manufacturer of industrial, commercial and household electrical heating devices. They're good points, too, for you to remember whenever you're called in on an electrical heating application. For, when you recommend heating elements made of Hoskins Chromel, you can assure your customers of the continuity of service they need and want.

Our Catalog M-1 contains helpful information for your Load Building Department . . . want a copy?



HOSKINS MANUFACTURING COMPANY

4445 LAWTON AVE. • DETROIT 8, MICHIGAN

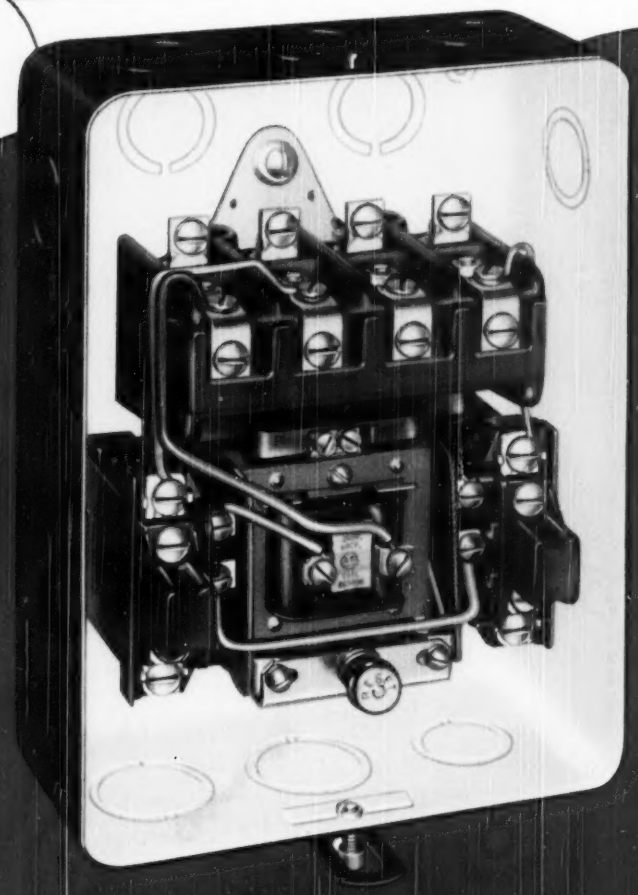
NEW YORK • CLEVELAND • CHICAGO

West Coast Representatives in Seattle, San Francisco, Los Angeles
In Canada: Walker Metal Products, Ltd., Walkerville, Ontario

**the original nickel-chromium resistance alloy that first made electrical heating practical*

Imitation is the sincerest of flattery

Charles C. Colton



WHY...

do so many starters look like Allen-Bradley Solenoid Starter

It is no coincidence that most starters today, look so much like the Allen-Bradley solenoid starter.

There was a time when they did look different. That was before Allen-Bradley brought out the bulletin 709, Size 1, solenoid starter. It embodied certain factory features which, today, are established as standard for modern motor controls. That explains why many other starters now resemble Allen-Bradley. But, for simplicity and dependability, Allen-Bradley starters have not been surpassed.

You can reap the benefits of this design leadership by specifying Allen-Bradley motor controls.

ALLEN-BRADLEY CO.
1316 S. Second St., Milwaukee 4, Wis.

ALLEN-BRADLEY

THE MOST IMITATED MOTOR STARTER

QUALITY

A-B Quality

"preferred" starter

Why?

- It's so simple
- It's so trouble free
- It's so easy to install
- It's so dependable

BULLETIN 709
Solenoid Starter
The world's simplest and most popular magnetic across-the-line starter

The dominant position of Allen-Bradley solenoid motor controls among machinery builders, plant engineers, and electrical contractors, has been revealed in repeated market surveys during the past 10 years.

These strong preferences . . . for Allen-Bradley starters . . . are due primarily to the four unique design features tabulated on this page.

Allen-Bradley starters rank first, year after year, among machine tool manufacturers . . . the most exacting control market in the world . . . because Allen-Bradley continually pioneers in control design and performance.

Let us send you a handy, condensed catalog of the Allen-Bradley line. If you are a manufacturer of motorized machines, you will find this new catalog a convenient reference manual on motor controls and related accessories.

1 **Only one moving part**

So *simple*—because trouble making parts have been reduced to a minimum. No pins, no pivots, no bearings, no linkages to corrode and stick.

2 **No contact maintenance**

So *trouble free*—because the double break, silver alloy contacts never need filing, cleaning, or dressing. Install Allen-Bradley starters—and forget them.

3 **Easy to install**

So *convenient to install*—because of ample wiring space, white cabinet interiors, accessible terminals, and plenty of convenient knockouts.

4 **Full line of enclosures—**

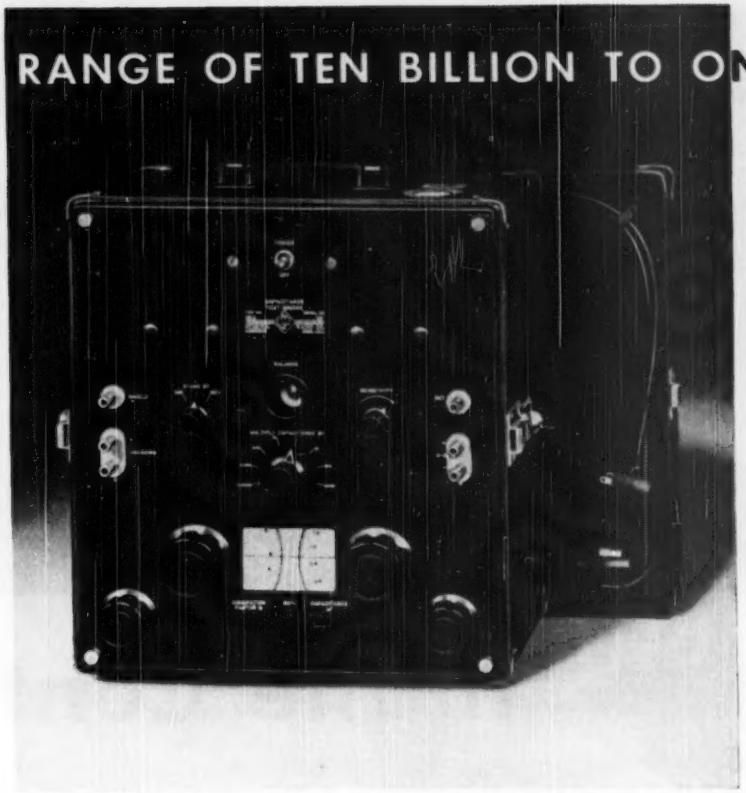
So *dependable*—because these switches can be supplied in exactly the types of enclosures for full protection from dust, fumes, or moisture.

ALLEN-BRADLEY
SOLENOID MOTOR CONTROL

A-B Quality

3504

A RANGE OF TEN BILLION TO ONE



WITH THIS CAPACITANCE TEST BRIDGE

DESIGNED as an improvement on the popular Types 740-B and 740-BG Capacitance Test Bridges, this new G-R Type 1611-A Bridge is an important advance in increased accuracy, sensitivity and convenience in operation.

This bridge measures capacitance from 1 $\mu\mu$f to 11,000 μf with an accuracy of $\pm$ (1% + 1 $\mu\mu$f) *over the entire range*. Among its many features are:

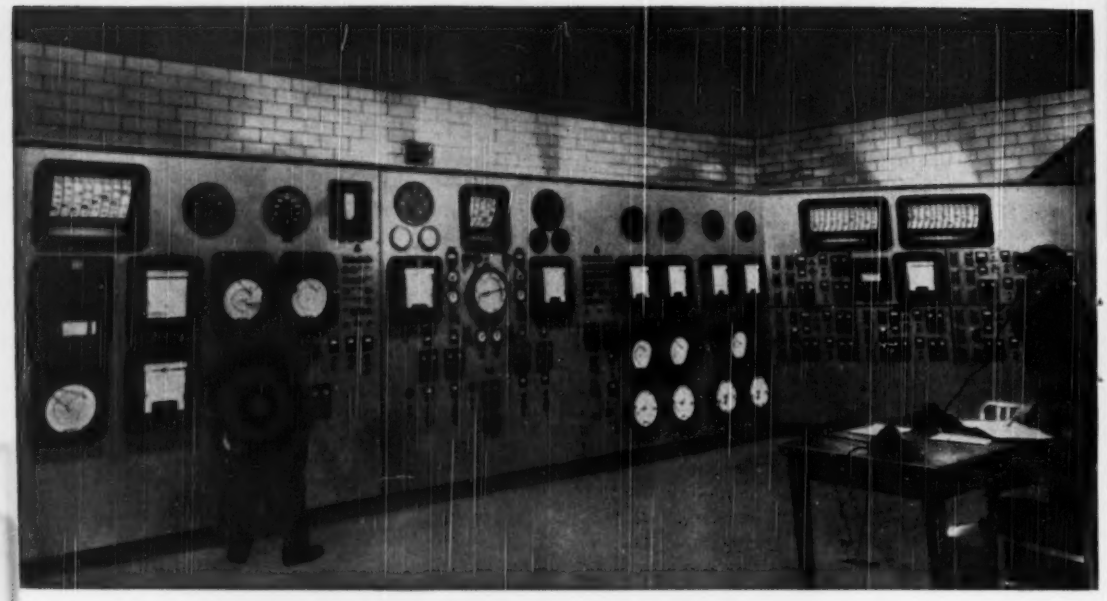
- **CAPACITANCE & DISSIPATION-FACTOR DIALS** direct-reading through a single window . . . dials aproximately logarithmic.
- **UNIQUE ZERO-COMPENSATING CIRCUIT** requiring no "zero" corrections for accurate determinations of capacitance and dissipation factor even at lowest bridge values.
- **HIGH SENSITIVITY** . . . capacitances between 100 and 11,000 μf can be balanced to a precision of at least 0.1%.
- **EXCELLENT DISSIPATION-FACTOR ACCURACY** of $\pm$ (2% of dial reading plus 0.05% dissipation factor) over entire range of 0 to 60% (at 60 cycles).
- **IMPROVED DETECTION CIRCUIT** with single-stage amplifier and electron-ray tube as visual null indicator . . . circuit designed to be very sensitive at or near balance and insensitive off balance.
- **POLARIZING VOLTAGE CAN BE USED** for external connection up to 500 volts d.c. One terminal grounded so that a-c operated power supply with grounded output can be used.
- **UNIFORM POWER DELIVERED TO BRIDGE**... four separate sources of proper impedance and voltage, each providing maximum safe power to bridge, automatically selected by multiplier ratio switch.
- **ADJUSTABLE LIGHT SHIELDING** by means of slotted cylindrical light shield around indicator tube . . . adjustable for different external light conditions.

This new bridge is very useful in the power industry for measurements of dissipation factor on bushings and insulators and electrical insulation. For the measurement of dissipation factor and dielectric constant of both solid and liquid dielectric materials in chemical and plastic laboratory this bridge provides a highly accurate, sensitive and convenient tool.

TYPE 1611-A CAPACITANCE TEST BRIDGE . . $395.00

GENERAL RADIO COMPANY Cambridge 39, Massachusetts

90 West St., New York 6 | 920 S. Michigan Ave., Chicago 5 | 1000 N. Seward St., Los Angeles 38



In the Control

PHILIP SPORN STATION

You'll find Bailey Controls at work helping operators to maintain top performance in terms of:

Efficiency—Most power per fuel-dollar

Reliability—Highest availability of unit

Safety—Least risk to personnel and equipment

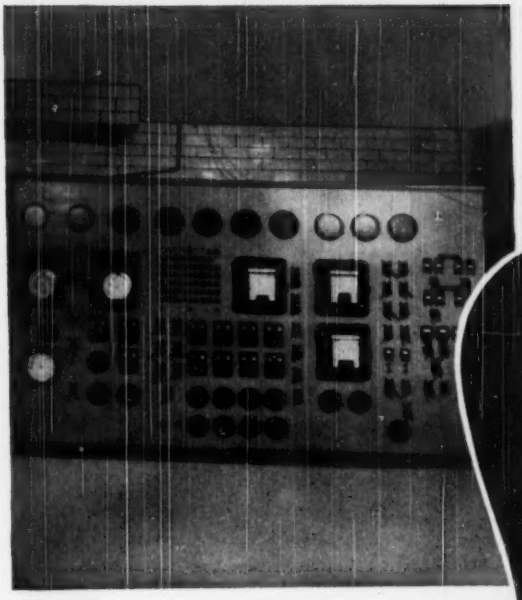
Bailey Controls can give unusually effective assistance to your operators too; because Bailey offers:

1. A complete line of fully co-ordinated metering and control equipment for all sizes and types of boiler units.
2. An experienced engineering service with a background of more knowledge and experience in steam plant operation than any other manufacturer of instruments and controls can offer.
3. Prompt and capable service with a minimum of travel time and expense. Bailey Sales-Service Engineers live in or near all major industrial communities.

Ask your local Bailey Engineer to arrange a visit to a nearby Bailey installation. We are proud to stand on our record: "More Power To You". A-110

Controls for Steam Plants

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS



PHILIP SPORN STATION

Room at...

You'll find These BAILEY CONTROLS

Combustion	Hot Well Level
Feed Water	Heater Levels
Superheat Steam Temperature	Condensate flow
Reheat Steam Temperature	Water Treatment
Deaerator Level	Pump Recirculation

BAILEY METER COMPANY

1060 IVANHOE ROAD • CLEVELAND 10, OHIO

BAILEY METER COMPANY LIMITED • MONTREAL, CANADA

When *these* tubes go in, they're in to stay!

CHASE ANTIMONIAL ADMIRALTY

(*a patented alloy*)

Here's the reason *why* Chase Antimonial Admiralty stays on the job year after year:

Admiralty with an antimonial content of less than .007% (the minimum set forth in Chase Patent No. 2,061,921) cannot be depended on to guard against dezincification under all conditions. Over a wide range of applications, protection calls for a minimum of .015%. And Chase boosts the nominal content to .035% . . . to make doubly sure that despite normal commercial variations every tube contains *at least* .015%.

This time-tested Antimonial Admiralty is Chase-patented. Get the facts today.

Special stocks of ANTIMONIAL ADMIRALTY Condenser Tubes in Chase Warehouses: NEW YORK, BALTIMORE, NEW ORLEANS LOS ANGELES, SAN FRANCISCO

also carried by—
Vinson Supply Co., Tulsa
Standard Brass & Mfg. Co., Houston

Chase

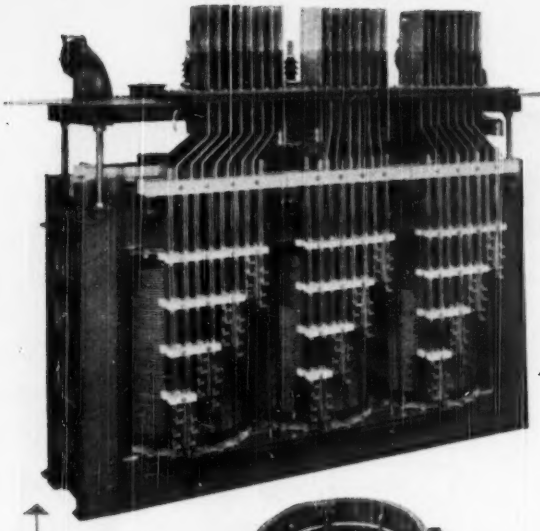
the Nation's Headquarters for
BRASS & COPPER

WATERBURY 20 CONNECTICUT

SUBSIDIARY OF KENNECOTT COPPER CORPORATION

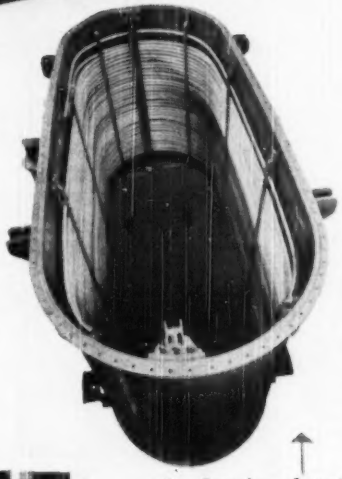
THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

ALBANY ATLANTA BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DALLAS DENVER DETROIT HOUSTON* INDIANAPOLIS KANSAS CITY, MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER ST. LOUIS SAN FRANCISCO SEATTLE WATERBURY *Sales Office Only

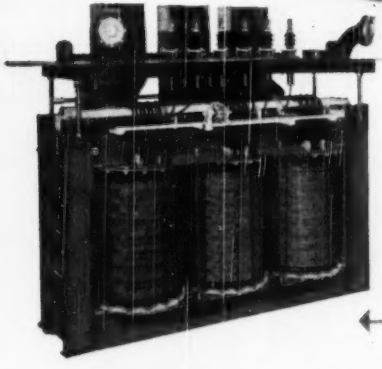


Low Voltage side. Note arrangement of bus bars.

12,000 Kva Furnace Transformer, 3 Phase, 60 Cycles, Water Cooled. High Voltage, 12,000 Volts. Low Voltage ranges from 375 down to 200 Volts, or full capacity. Maximum Low Voltage line current — 34,600 Amperes. High Voltage brought out with six bushings for star connection to obtain a lower range of low voltages.



Interior of tank showing arrangement of copper water cooling tubes.



High Voltage side. Pennsylvania's 3 Phase straight line tap changer mounted above core and coil unit can be quickly and easily inspected and maintained through cover manholes.

Recently installed 12,000 KVA Furnace Transformer raises total of PENNSYLVANIA FURNACE TRANSFORMERS in service to 1¼ MILLION KVA

When this 12,000 Kva Furnace Transformer was put into service, it brought the total installed Kva of Pennsylvania Furnace Transformers to over 1¼ million Kva.

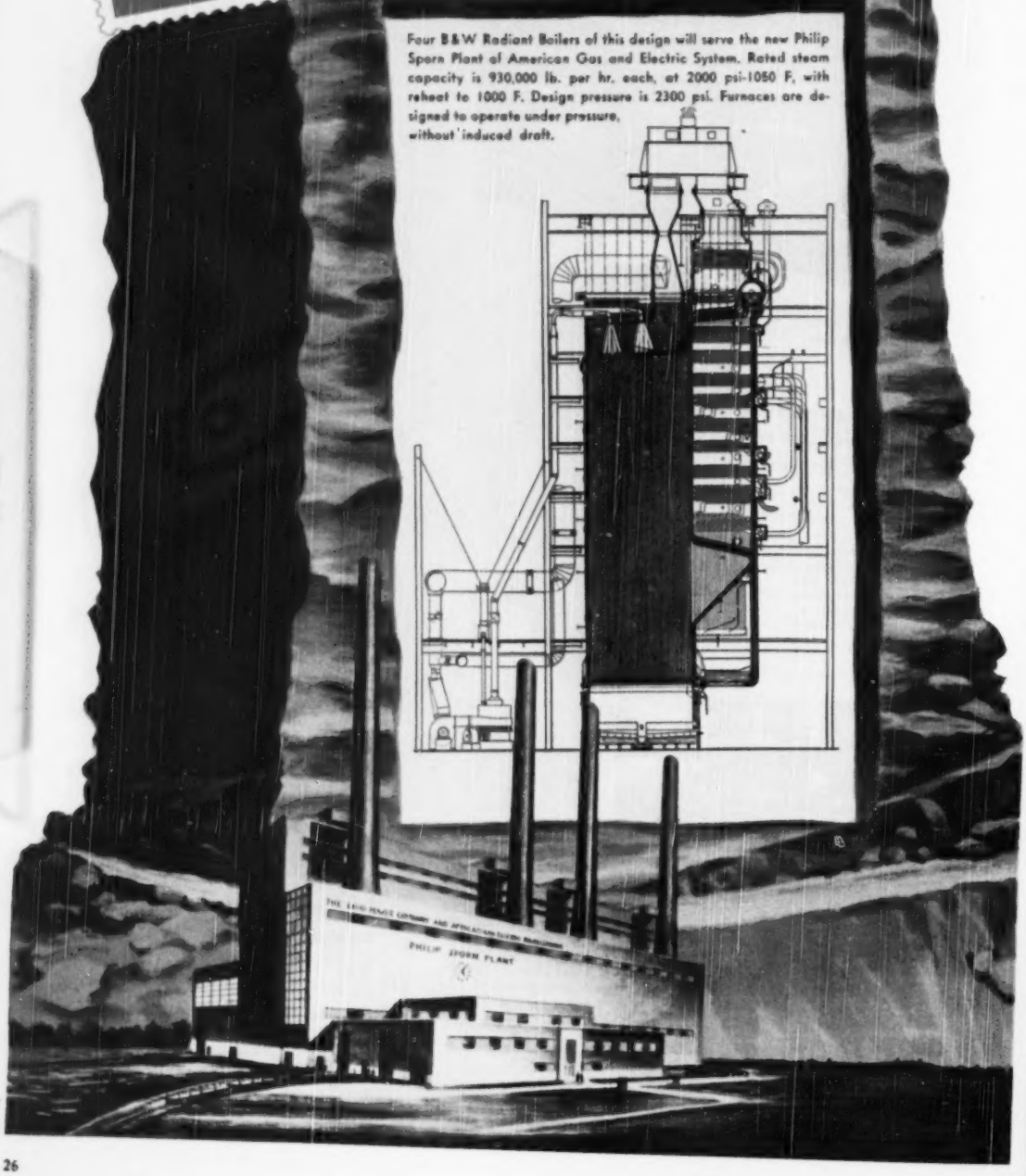
The successful operation of Pennsylvania Furnace Transformers and their industry-wide acceptance indicate that Pennsylvania engineers fully understand the problems of electric furnaces and their relation to furnace transformers.

Pennsylvania TRANSFORMERS

Pennsylvania TRANSFORMER COMPANY

CANONSBURG, PENNA. • Greater Pittsburgh District

Another Example of B&W Engineering for Economy



Four B&W Radiant Boilers of this design will serve the new Philip Sporn Plant of American Gas and Electric System. Rated steam capacity is 930,000 lb. per hr. each, at 2000 psi-1050 F, with reheat to 1000 F. Design pressure is 2300 psi. Furnaces are designed to operate under pressure, without induced draft.

A NEW Milestone

IN EFFICIENT POWER GENERATION

First of its kind, the new Philip Sporn Plant of American Gas and Electric System has the lowest station heat-rate in steam-electric generating history. Utilizing reheat and the highest pressure-temperature combination ever employed throughout an entire central station, its four B&W Radiant Boilers will supply all the steam required for 600,000 new kw. of electric-generating capacity.

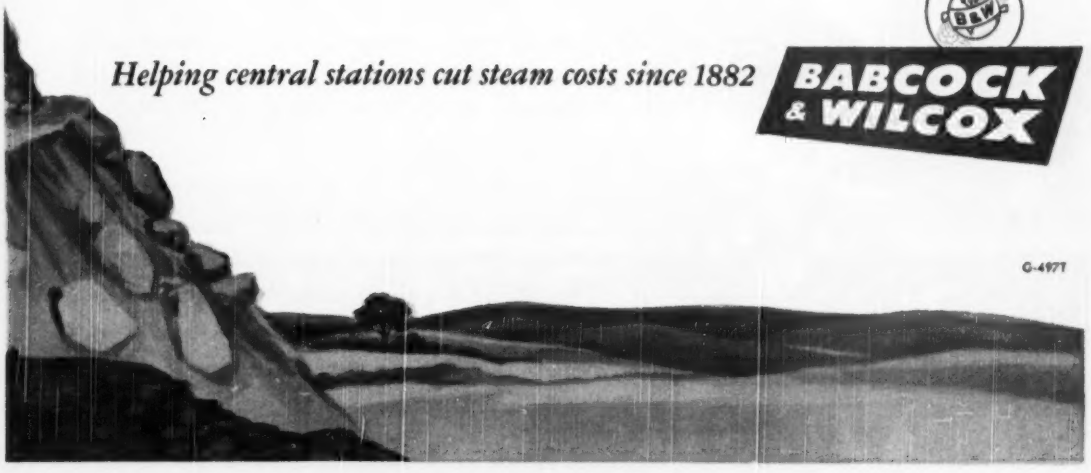
Setting records in power generating efficiency is an old story with American Gas and Electric. And *helping* to set them, through cooperation with this utility's far-sighted and courageous management, is an old story with B&W.

As the search continues for still more and better ways to keep power costs down, B&W will continue, in cooperation with power companies, to apply the advanced thinking and research that have produced so many other notable milestones in the steady advance toward today's highly efficient, economical power generation.

Helping central stations cut steam costs since 1882

BABCOCK & WILCOX

G-4977



NO CRACKING OF VARNISH!

NO BREAKING OF LEADS!

New!

IRVINGTON #123 insulating VARNISH

Stays flexible after baking!

UNSURPASSED FOR

TRANSFORMERS

RELAYS

COILS OF ALL TYPES

Here's a new insulating varnish that's packed with performance characteristics that really pay off! For here's a varnish that soaks deep into coil windings... bakes throughout to form a tightly bonded mass... yet *stays flexible on leads!*

Yes, Irvington's new #123 varnish does just that – lets you twist and bend coil leads after baking, without danger of cracking varnish, without risk of breaking tiny wires! Cuts spoilage, simplifies assembly, helps assure uniformly high quality for *your* product!

You'll find #123 varnish ideal for transformer coils, solenoids, all windings where leads must remain flexible after varnishing and baking. For full details, test results, samples . . . write today.

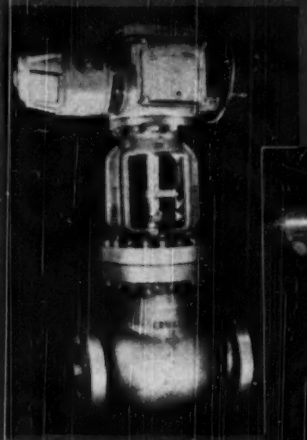
Look to Irvington
for Insulation Leadership

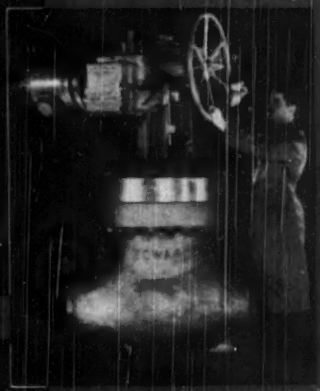
IRVINGTON VARNISH & INSULATOR COMPANY
Irvington 11, New Jersey

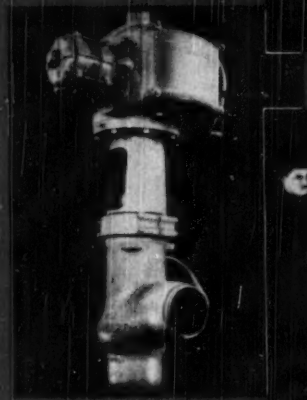
PHILADELPHIA

LIMITORQUE

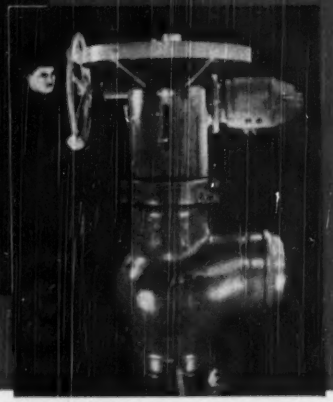
...THE MODERN OPERATOR THAT MATCHES THE LATEST TRENDS IN VALVE DESIGN







Photos courtesy Edward Valves, Inc.



Continued advancements in the design and construction of LimiTorque Valve Controls always keeps them abreast with the latest developments in valve manufacture.

LimiTorque opens and closes valves of all makes and types up to 96" diameter by the "push of a button" from either remote or nearby control panels. Damage to stem, seat, disc, gate or plug is prevented because the Torque Seating Switch *limits the torque*, shuts off the motor if an obstruction occurs.

Valves function at maximum desired speeds.

Greater safety is afforded workmen by LimiTorque Remote Control as it is unnecessary to go to high, low or dangerous locations for manual operation.

LimiTorque may be supplied for actuation by any available power source . . . electricity, steam, water, gas, oil or air.

LimiTorque Controls are available through valve manufacturers. Thousands are in daily use on land and sea . . . in Power Plants, Central Stations, Water Works, Refineries, and Oil Pipe Lines.

Send for our 96 page catalog.
Please make request on your business letterhead.

Philadelphia Gear Works, INC.

ERIE AVE. AND G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON
IN CANADA: WILLIAM AND J. G. GREEY LIMITED, TORONTO

Industrial Gears and Speed Reducers
LimiTorque Valve Controls

YOU CAN BE **SURE**.. IF IT'S
Westinghouse

These are just three of the many sizes and types that are made available to you in Westinghouse Portable Instruments—the most complete matched line in the Industry. For all your portable instrument requirements, refer to Westinghouse Catalog Section 43-100—ask your nearest Westinghouse Representative.

Get more for your instrument dollar!

1. The most complete matched line

in the industry . . . for every portable requirement.

2. Shipments in 10 days!

Shipments can be made for practically every requirement for portable electrical measuring instruments within 10 days of receipt of order at factory.

3. Assured A.S.A. standards.

Every Westinghouse Portable Instrument is designed and built to meet the rigid standards of the American Standards Association.

AND . . . you get the famous Westinghouse *controlled quality* that assures you of permanently white dials, springs that remain constant for life, magnets that remain stable, low-friction pivots, high overload capacity and uniform scale distribution.

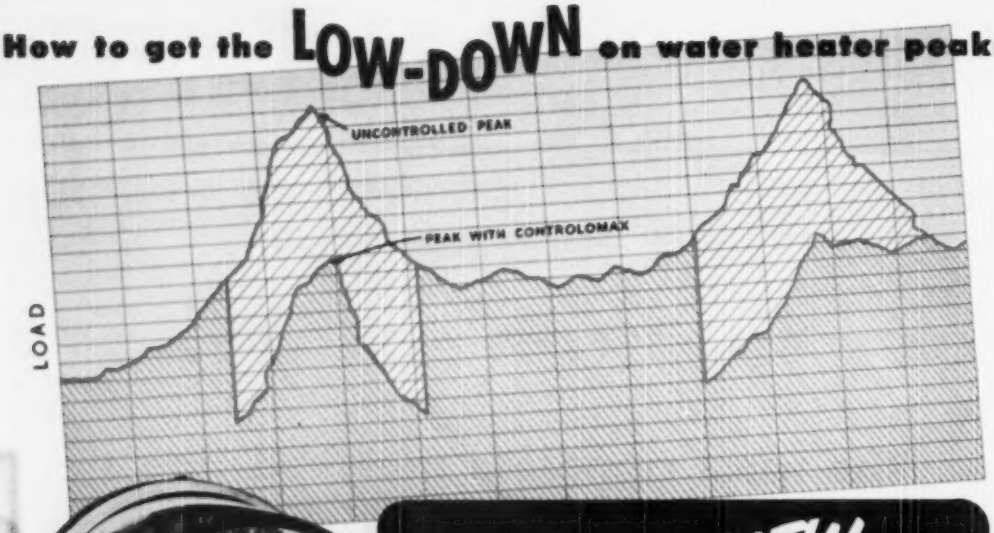
Westinghouse Instrument Specialists are available at all times to assist you with *your* electrical measuring problems. Their nationwide experience enables them to solve instrument application problems of *all* types. Phone, write or wire your nearest representative. For the complete story on portable instruments, ask for C. S. 43-100. Westinghouse Electric Corporation, 95 Orange Street, Newark, N. J.

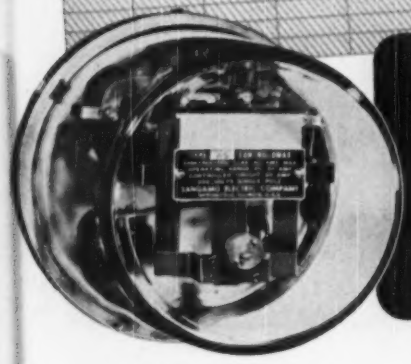
J-40392

Specify Westinghouse *and be SURE of all three!*

Westinghouse
INSTRUMENTS

How to get the LOW-DOWN on water heater peaks





with the *NEW* SANGAMO CONTROLOMAX

Type AS (Socket) Enclosure

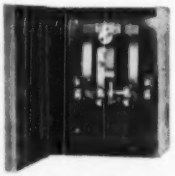
To assure profitable returns from water heater loads, the effect of their demands must not result in costly peaks, as is the case when electric ranges, ironers, clothes dryers or other large current consuming devices are used at the same time water is being heated.

Now, an exceptionally simple control device, the new Sangamo Controlomax, will prevent water heater demands from adding to these peaks. When load currents reach pre-determined levels the water heaters are disconnected. As soon as the load current is reduced to an established level, the water heater is re-connected. Thus, on the basis of consumers' load and use habits, peaks are reduced and long charging periods and low demands will result.

The Sangamo Controlomax is an automatic thermal switch. A bimetallic strip with a slow, positive motion operates a contact. Maintenance will be practically nil. Time settings are unnecessary. The first cost is low, and operating costs are at a minimum.

Now, Sangamo adds to its complete line of time switches and meter-time switch combinations for *time* control of water heater peaks, a simple thermal control based on the *magnitude of the consumer's load.*

Write for bulletins on the complete line of controls for electric water heater loads.



Type AB (Box) Enclosure

SANGAMO ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

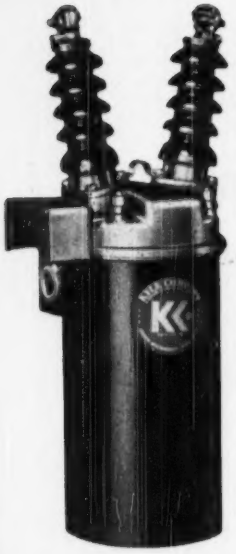
KYLE RECLOSERS

Kyle reclosers offer complete protection for lines, and safety for linemen. They are the original, and still the best, automatic protection for both single and three-phase lines. They offer flexibility to meet all conditions, and precise coordination with fuses, sectionalizers, other reclosers, and station breakers. They avoid lockouts and outages, cut maintenance, and protect your equipment and service.

Outstanding Kyle Recloser Features

Three reclosures before locking out; choice of four opening sequences . . . Coils and sequences easily changed in the field . . . Trip-free operating handle. Tank and cover are dead; bushing terminals are the only live parts . . . Positive dependable operation—no motors or clockwork . . . Large cast aluminum cover; sleet hood protects operating handle and counter . . . Ratings 5 to 50 amps.; 2400 to 15,000 volts; minimum tripping current 10 to 100 amps.; interrupting capacity 150 to 1200 amps.

. . . ON SINGLE-PHASE . . . AND THREE-PHASE LINES



◀ KYLE

TYPE H

Single-phase recloser

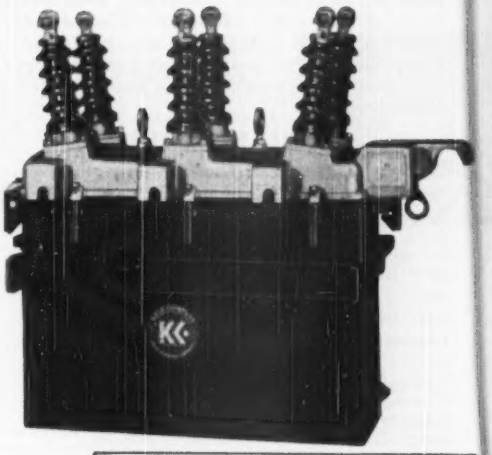
Protects feeders and branch lines on both single- and three-phase systems by coordinating with fuse links, sectionalizers, and other reclosers. Isolates permanent faults to small parts of a system and thus cuts amount of patrolling required.

KYLE ▶

TYPE 3H

Three-phase recloser

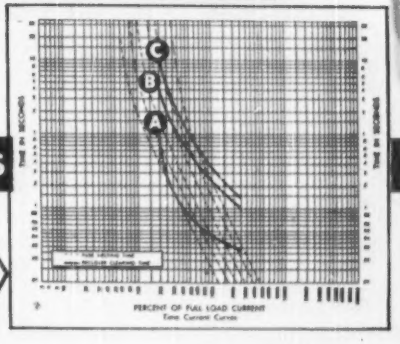
A practical combination of single-pole units so as to permit single-phase operation of any of the three-phase units so long as no lockout is required. If any one unit locks out, the other two lock out simultaneously. Prevents "single phasing" and overloading and burning out 3-phase motors. 7119



CHOICE OF 4 OPENING SEQUENCES

Curves show recloser action on each sequence:

1. Curve A—four fast openings.
2. Curves A and B—two fast, two retarded openings.
3. Curve C—four extra retarded.
4. Curves A and C—two fast and two extra retarded.



For complete information ask the L-M Field Engineer or write Line Material Company, Milwaukee 1, Wisconsin (A McGraw Electric Company division).

LM

LINE MATERIAL Kyle Reclosers

7119

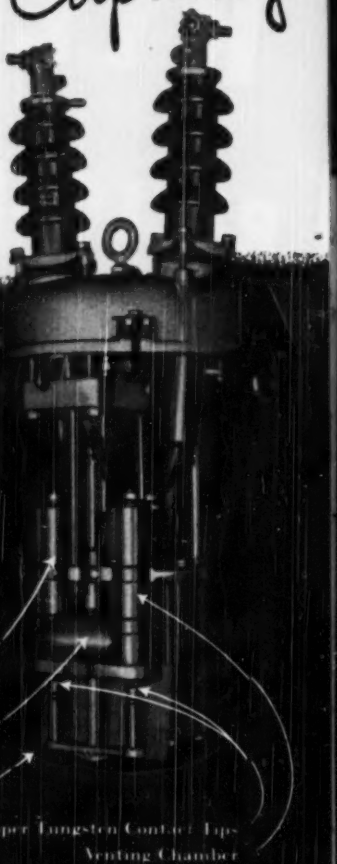
Complete Coordinated Equipment for All Distribution Requirements

UP TO

4,000 Amps. Interrupting Capacity

IN THE TYPE "L"

KYLE OIL CIRCUIT RECLOSER



This was the first recloser actually designed and engineered for heavy duty service; its performance has proved its quality. Gives Kyle recloser protection with all the outstanding Kyle features, on lines with loads up to 100 amps and fault currents as high as 4000 amperes. These heavy fault currents can be handled successfully because of the Kyle *oil cross blast* method of arc extinction.

SPECIAL FEATURES

This heavy duty type L recloser offers:

Operating voltages, phase to phase, 2.4 to 15 kv

Ratings: 25, 35, 50, 70, and 100 amperes, for minimum tripping currents of 50, 70, 100, 140, and 200 amps, respectively. Coils are interchangeable in the field

Precise coordination with line or back-up fuses, sectionalizers, other reclosers, and breakers

Insulation level meets A.S.A. standards for 15 kv power circuit breakers. **Impulse** level 110 kv

Control mechanism fully hydraulic, virtually free from variations caused by oil temperature viscosity changes; rugged, shock-proof; trouble-free. Trip-free operating handle; many other safety features

Size approximately 37" high, tank 11" diameter. Large sleet hood protects operating handle and counter; may be rotated in 90 degree steps

Weight with oil, 170 pounds

Greater Accuracy; Wider Choice of Operating Sequences

Three reclosures before locking out. Standard sequence is two fast operations, two retarded (two curves A, two curves B in chart).

Optional Sequences easily changed in the field: four fast operations (four curves A); or two fast and two extra-retarded (two curves A, two curves C).

Other Sequences and time current curves available from the factory.

LINE MATERIAL COMPANY, Milwaukee 1, Wis.
(A McGraw Electric Company Division)

New oil cross blast arc extinction!

Provides minimum arcing time and freedom from restrikes at all current values and power factors within the recloser rating. Arcs are drawn in series. Arc in the pressure chamber forms gas which blasts oil into the venting chamber, extinguishing the arc.

Pressure Chamber

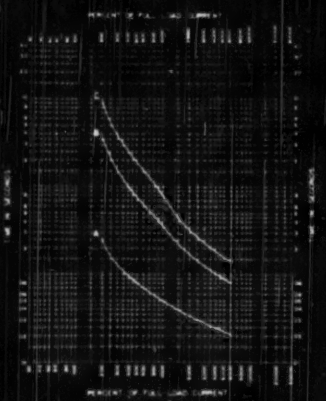
Cross Blast Chamber

Quick Make, Quick Break Contact Action

Copper Tungsten Contact Tips

Venting Chamber

Time Current Curves!



Read all about it!

Get the whole story, in this easy-to-read illustrated bulletin. Ask the L-M Field Engineer for a copy or write **Line Material Company, Kyle Products Plant, Milwaukee 1, Wis.**

LINE MATERIAL KYLE RECLOSERS

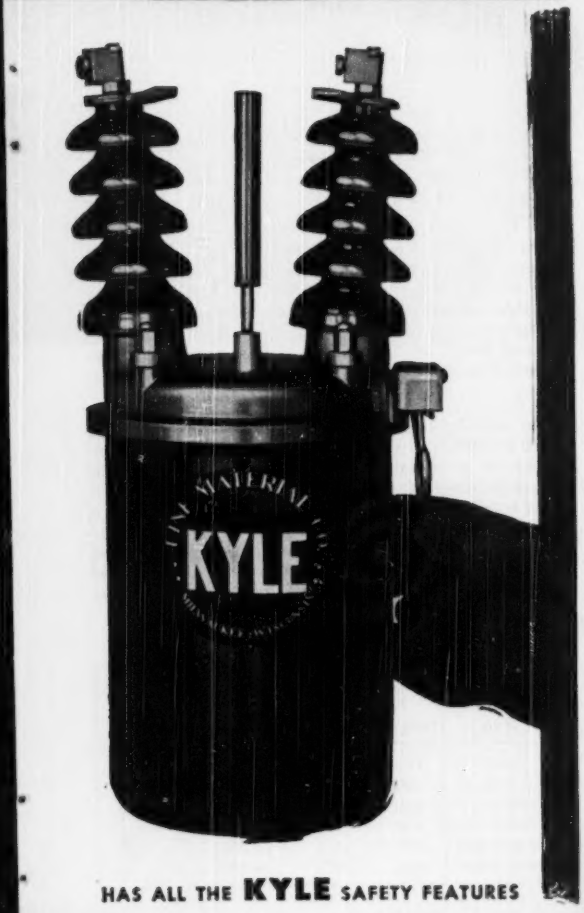
Complete Coordinated Equipment for All Distr

KYLE TYPE GS AUTOMATIC OIL SECTIONALIZER

Isolates permanent faults on branch lines of recloser-protected systems

Kyle automatic oil sectionalizers provide dependable automatic protection against permanent faults on branch lines. They do not open on temporary faults, but operate to disconnect the branch only after one, two, or three operations of the back-up recloser have failed to clear the fault. After the third recloser operation, the contacts of the sectionalizer open up while the recloser is open. Thus the faulted branch is disconnected, and the recloser resets itself and maintains service on the rest of the system.

The sectionalizer may be set to open on a permanent fault after one, two, or three operations of the recloser, as desired. Since the sectionalizer does not interrupt short circuit currents, contacts last indefinitely, and there is no carbonization of the oil.

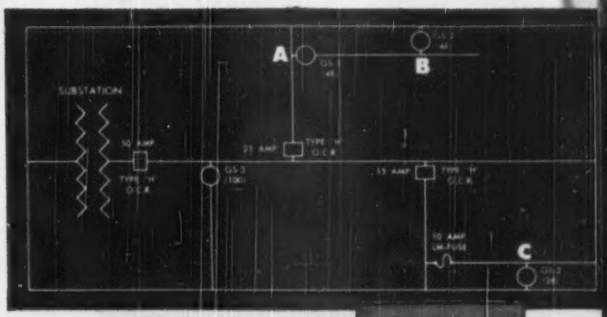


Get the whole story !

For details, dimensions, ratings, mountings, and a complete description of how Kyle type GS sectionalizers operate, ask the L-M Field Engineer for a copy of this Bulletin CR3, or write Line Material Co., Box 2077, Milwaukee 1, Wisconsin.

To Protect Your Lines with Kyle Type GS Sectionalizers

The diagram shows how it is done: *Point A* shows a sectionalizer set to open on the third recloser operation, indicated by GS-3. *Point B:* further sectionalizing by setting the sectionalizer to open on the second operation of recloser—indicated by GS-2. *Result:* a permanent fault beyond *B* causes sectionalizer GS-2 to lock out after second recloser operation; service is maintained on the branch protected by sectionalizer GS-3 at *A*. *Point C:* Sectionalizer GS-2 set to open on second recloser operation isolates a permanent fault before the back-up fuses are damaged or blown by the third operation of the recloser. Kyle Sectionalizers also will replace branch line fuses on systems protected by Kyle Type H Reclosers, giving you complete automatic protection.



HAS ALL THE KYLE SAFETY FEATURES

1
Tank, cover, and operating handle are dead. Tank may be grounded.

2
Mechanism cooled, and insulated from tank, by transformer oil.

3
Standard cover type bushings. Terminals are the only hot spots.

4
Trip-free operating handle.

RATINGS:

Seven sizes, with minimum tripping current 8 to 100 amps to coordinate with reclosers rated from 3 to 50 amps; maximum operating current 150 to 1200 amps; 2400 to 15,000 volts. Ratings may be changed by changing coils in the field. Weight with oil about 20 pounds. Crossarm or direct pole mounting hangers.

7128

LINE MATERIAL Kyle Sectionalizers

Complete Coordinated Equipment for Distribution Today

IT TAKES LESS THAN

half the torque

TO TIGHTEN THIS

KYLE type HD two-bolt HEAVY DUTY CONNECTOR

Here's an ideal connector for heavy stranded wire from 2/0 to 1000 MCM. It's easy on cable; gives a firm, low-resistance connection that stays cool; bolts won't drop out; it's easy to tighten, and it just won't come loose!

The tightening force is applied by two bolts which accommodate the standard lineman's wrench instead of the large wrench required for split bolt connectors of the same size. As the table below shows, tightening torque required is quite low—which linemen will like—and which, along with the copper spacer bar, prevents crushing and distortion of strands.

Easy to Install

The self-aligning body and cap insure easy starting and threading of the bolts. The bolts are held in the body by a retaining ring, making it impossible for them to drop out during installation. The spacer is also retained in the body for proper positioning. It is only necessary to place the connector over one conductor, engage the bolts, insert the tap wire, and tighten. The connector will take two conductors of the rated size, or one conductor of that size and any smaller size tap-off.

Easy to tighten — stays tight!

SIZES	RECOMMENDED TIGHTENING TORQUE	
Stranded Wire	Per Bolt, for type HD Connectors	For Split Bolt Connectors
2/0	120 inch-pounds	600 inch-pounds
4/0	200	750
350 MCM	275	900
500 MCM	350	1000
750 MCM	500	1200
1000 MCM	600	1400

Photo shows the 350 MCM size of the Kyle HD Connector. Body and cap are copper base alloy; spacer bar is copper; bolts are silicon bronze. The connector is also furnished zinc plated, for conductors other than copper. It is designed so as to give a tight, low-resistance connection without distortion of the strands. The nicely-rounded body makes it easy to do a good tape job. The connector is easy to tighten, stays tight, and has many other advantages over split bolt connectors—yet it costs even less! It's a good job, and a good buy for you. Why not try it?

For samples and prices ask the L-M Field Engineer; or write or wire Line Material Company, Box 2077, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

7910

LM®

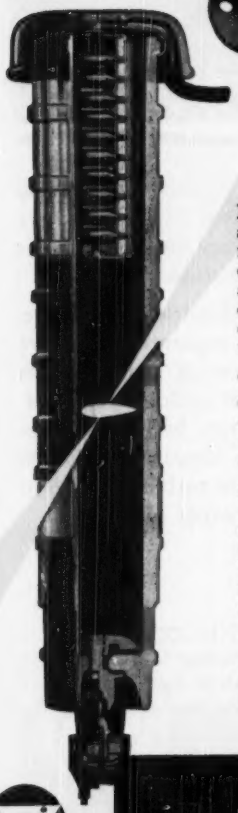
LINE MATERIAL Kyle Connectors

Complete Coordinated Equipment for Distribution Today

PROTECTION TODAY

LENS

for a lightning arrester



Here is how L-M Valve Type Arresters counteract "skin effect," and why L-M's "Granulon" characteristic element has such high discharge capacity and unchanging characteristics.

Lightning follows the path of least resistance—electrically. Also, like 60-cycle current in a conductor, it tends to "skin" down the outside of the valve element. In a lightning arrester, when the resistances down the middle and side of the valve element are the same, the surge invariably tends to channel down the outer edges.

The result? Repeated surges lower the discharge capacity, and in time the arrester clinkers, and fails. Usually nobody knows why, and attributes the failure to a direct stroke.

In L-M's "Granulon" characteristic element, *lens-shaped metallic electrodes* shorten the electrical distance down the center just enough to counteract the skin effect. The surge discharges evenly all through the "Granulon"—and the arrester lasts far longer.

The arrester can take *more* heavy surges . . . it maintains its high discharge capacity without change for years and years . . . rate of failure is gratifyingly low.

(Incidentally, that is why L-M is the only manufacturer who *dares* to put his arrester into a Pyrex® glass housing. You can *see* any signs of failure—which is so rare in L-M arresters we don't mind taking the cat out of the bag!)

Other features: precision gap, maintains low sparkover and fast action on both long low and steep front waves . . . draws negligible follow current—permits accurate fuse coordination . . . The Isolator, L-M's patent insurance feature—the arrester can never ground feeders. In all distribution voltages . . . Meets NEMA Standards and more!

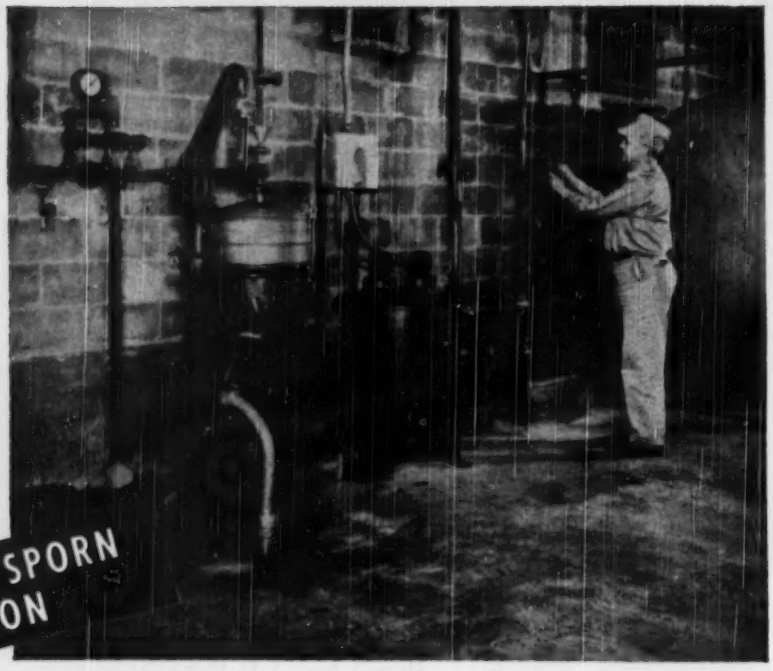
GET THIS BOOKLET—JUDGE FOR YOURSELF

Ask the L-M Field Engineer for a copy of Bulletin LA1, or write Line Material Company, Milwaukee 1, Wisconsin (A McGraw Electric Company Division)

7488

LINE MATERIAL Lightning Arresters

Complete Coordinated Equipment for Distribution Today



DE LAVAL *PROTECTS* the *TURBINES*

This De Laval centrifugal Oil Purifier installed at Philip Sporn Station provides positive protection for the turbines. It removes from the turbine oil sludge or any solid impurities that may be picked up, and it also separates and continuously discharges any moisture that may be in the oil.

Thus, the De Laval centrifuge provides ***two-way*** protection. It guards the power unit against ***both*** of the chief causes of lubricating oil contamination —dirt and water. Wholly mechanical in operation, De Laval Oil Purifiers are the logical choice of operators who want their oil to be really ***clean and dry***.

A wide range of capacities is available. Machines requiring separate pumps are provided in sizes having a purification capacity up to 1,000 gallons per hour. "Uni-Matic" machines, built with integral pumps, have a capacity up to 450 gph., Navy rating, on turbine oil (up to 550 gph. on certain other oils.)

● Write for additional information.

De Laval

THE DE LAVAL SEPARATOR COMPANY
165 Broadway, New York 6 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

LUBRICATING OIL PURIFIERS

they couldn't afford a *SHORT CIRCUIT*

PROTECTION IS UNLIMITED with EC&M VALIMITOR (VOLT-AMPERE-LIMITOR) STARTERS

There's no ceiling on VALIMITOR protection because fault currents are limited to a maximum of 25,000 KVA (steady state current) and the well-known Type ZHS Contactor used in these starters clears such faults quickly.

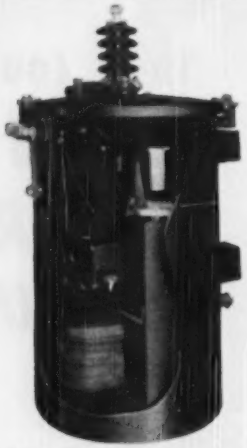
Because protection is *unlimited*—there's no need for calculating existing short circuit capability—no need to fear that these starters will be outmoded by future growth in KVA.

Also there are no fuses to replace after a fault. EC&M 2300-4600 volt VALIMITOR Starters give *permanent* protection.

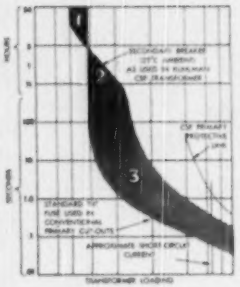
Write for COMPLETE FACTS—ASK FOR No. 23 ACCELERATOR BULLETIN

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

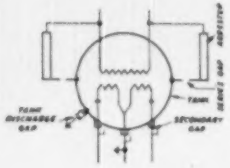
How KUHLMAN CSP transformers give you greater protection



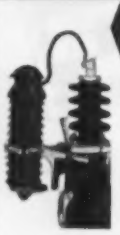
The Kuhlman CSP Transformer is a completely self-protected unit. You need no extra equipment such as primary and secondary fuse devices or external lighting arresters — all are built-in. With this transformer, there is no sacrifice of customer service since the CSP breaker safely permits overloads that would be dropped by the cutout fuse of a conventional transformer.



Steady operation regardless of power surges and overloads is routine with the CSP circuit breaker. Despite the name, the breaker *holds* the peaks which are so important in protecting customer service. The diagram shows how the CSP provides better protection by dropping dangerous overloads which might damage installation and by *holding* short-time overloads unnecessarily dropped by conventional transformer cutouts.



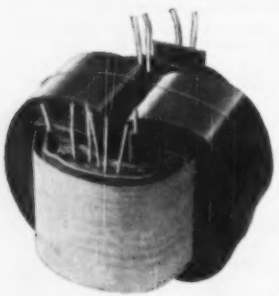
When lightning strikes with its devastating power, it is harmlessly turned aside by the arrester with no service interruption. This arrester is of the expulsion type which by-passes but does not absorb the lightning charge.



Cover mounted arresters are standard equipment on CSP transformers, 7200 volts and up.

Tank wall mounted arresters are standard equipment on CSP transformers through 4800 volts.

The breaker operating handle has "Open", "Close", and "Reset" positions and can be operated from the pole with hot stick. Available with emergency control lever (as shown) for temporarily raising temperature limits.



The famous Kuhlman Bent Iron Core utilizes oriented silicon steel with its superior flux carrying qualities to save steel, copper and oil, and provide a 25% weight saving margin over hot rolled cores.

Lapped joint construction provides 75% reduction in exciting current over butt joint cores.

Cooler operation of the transformer is assured by ample oil ducts in the windings to allow free oil circulation. 01-A

Further information on Kuhlman CSP Transformers can be had by writing for this new Bulletin CS-301. Kuhlman also manufactures a complete line of Distribution, Power, and Specialty Transformers. Bulletins on request.

EXPERIENCE COUNTS — THIS IS OUR 56TH YEAR

Kuhlman

KUHLMAN ELECTRIC COMPANY

BAY CITY, MICHIGAN

Export Representatives: *International Standard Electric Corporation*
67 Broad Street, New York City, N. Y. Cable Address: Microphone, N. Y.

Save Time on Every Job!

Order ALL Your Insulators and Accessories from Porcelain Products Inc.

Buy all your distribution and transmission insulators and accessories from one reliable source. Round out and complete your stocks with PORCELAIN PRODUCTS' complete line of performance-tested wet process porcelain insulators, and save time on both maintenance and new construction. Ask us to send a representative to discuss your needs. Catalog and price information sent on request.

Porcelain Products, Inc.

PARKERSBURG, WEST VIRGINIA

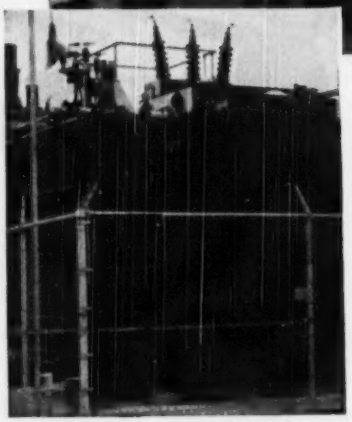
EXIDE-MANCHEX BATTERIES

assure positive switchgear operation at St. Louis, Prairie Substation of Union Electric Company of Missouri

In this modern substation, the 60-cell DME-11 Exide-Manchex installation is used for D.C. control circuits, including switchgear tripping and closing, and emergency lighting. Exide-Manchex Batteries were chosen for their well-known dependability, long life, low cost maintenance and many outstanding features which are equally important to you. They include . . .

- the famous manchester positive plate with its *exclusive* lead button construction.
- slotted plastic separators, impervious to chemical and electrical reaction.
- plastic spacers that maintain perfect plate alignment.
- the latest development in molded glass jars.
- heavy terminal posts with copper inserts for extra conductivity.

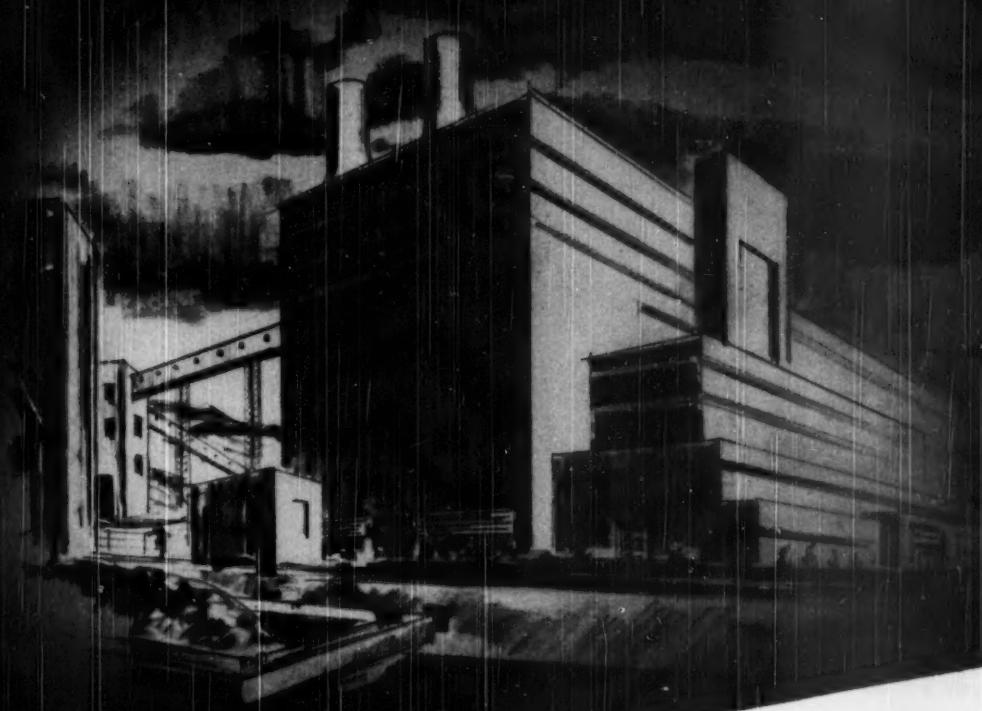
Combined, these Exide-Manchex features assure you dependable power for positive operation of switchgear . . . an adequate and uninterrupted supply of current for all your stationary storage battery requirements in central and substation service.



1888
DEPENDABLE BATTERIES FOR 62 YEARS
1950

"Exide" and "Manchex" *Reg. Trade-marks U. S. Pat. Off.*

THE ELECTRIC STORAGE BATTERY COMPANY • Philadelphia 32 • *Exide Batteries of Canada, Limited, Toronto*



DUQUESNE LIGHT COMPANY'S new Elrama power plant, near Pittsburgh, now under construction by Dravo, will increase Duquesne's system capacity by almost 25%. Dravo will serve as construction agent for the entire project, including a coal unloading dock, a mechanized coal-handling system, outdoor switching facilities and a screen house. This is the third large-scale power project entrusted to Dravo by Duquesne Light within the past two years.

DRAVO CORPORATION

POWER DEPARTMENT

Let us be your Construction Department

ENGINEERING CONSTRUCTORS

DRAVO

CORPORATION

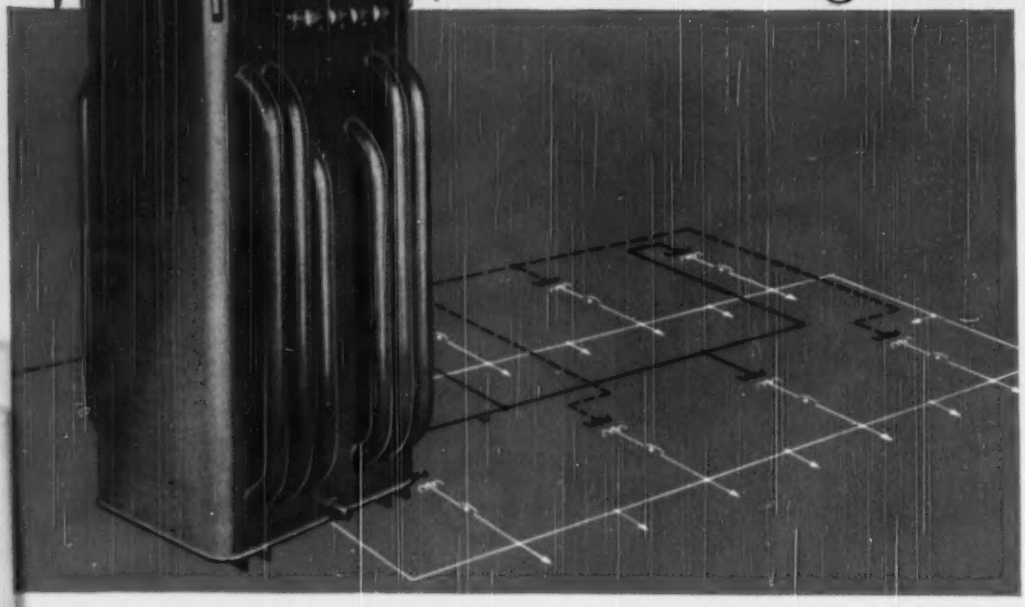
DRAVO BUILDING, PITTSBURGH 22, PA.

Engineering constructors of power plants, boiler plants, central stations, compressor stations, water pumping stations. Fabricators and erectors of power piping. Machinery installation. Power and boiler plant equipment.

PITTSBURGH · PHILADELPHIA · CLEVELAND · NEW YORK · DETROIT

DRAVO

YOU CAN BE **SURE**.. IF IT'S
Westinghouse



EXTEND NETWORK ADVANTAGES
to "Borderline" Areas

Where areas of your system make it difficult to justify an underground network, Westinghouse Type "S" Transformers help make economical overhead networks possible. Thus, the advantages of greater service continuity and system flexibility can be extended to heavy-load residential sections, light business districts and similar "borderline" areas.

No matter what type of network system you plan, or what your installation problems may be, Westinghouse can help you keep costs down . . . now . . . and in the future.

HERE'S WHY:

Now —There is a Westinghouse Network Transformer specifically designed to answer each of your network problems. In addition to TYPE "S", there are LIQUID-FILLED (oil or Inerteen®), most economical for general use; "ASL" VENTILATED DRY-TYPES, ideal for indoor service; and SEALED DRY-TYPES, the safest transformers ever built. Standardized construction provides lower initial cost and lower installed cost, too. Special hook-up problems are eliminated.

And in the Future —Years of leadership in the design and construction of network transformers show in the high quality and maintenance-free operation of Westinghouse Transformers. In addition, our complete facilities . . . engineers and calculating boards . . . are available to help you in your network planning, to make future expansion more economical.

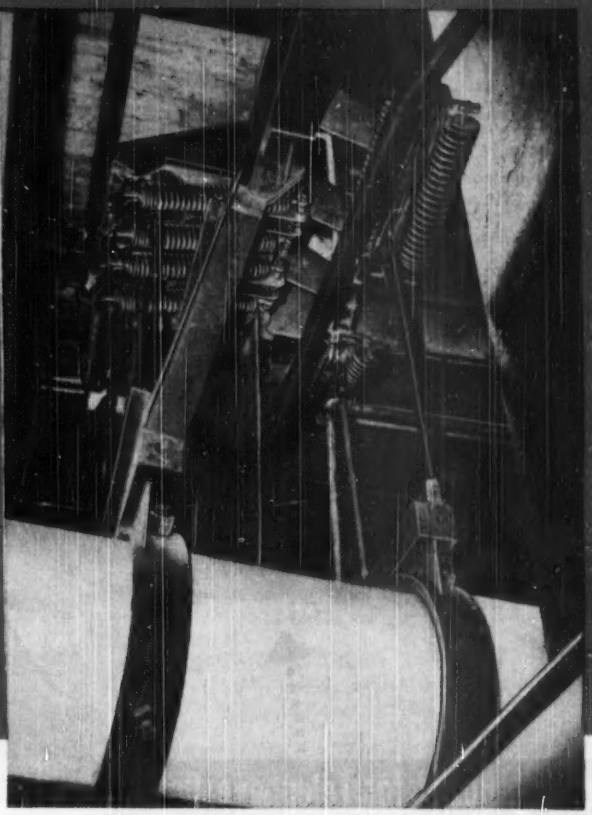
Ask your Westinghouse representative for further information, or write for Booklets B-4082 and B-4002-A. Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70559

Westinghouse
NETWORK TRANSFORMERS

Superheater Outlet at Philip Sporn Station

(1050°F. and 2000 p.s.i.)

Supported by Grinnell Constant Support Hangers



For The Babcock & Wilcox Company, designers of the steam generating equipment, Grinnell Constant-Support Hangers played an important part in the solution of the problem of completely supporting, at all times, the connection from the superheater outlet to the turbine as it moves from the cold to hot positions.

In addition, for American Gas and Electric Service Corporation, designers of the Philip Sporn Station, Grinnell Company designed and detailed the pipe suspension system and furnished all the pipe hangers.

Believing that a good piping job is too important to be jeopardized by inadequate pipe hangers, Grinnell has developed a complete line of hangers and supports for every piping need from a simple water pipe to a high pressure, high temperature steam line. Write for Catalog 10-D.

100th ANNIVERSARY — AMERICAN PIPING

GRINNELL

Grinnell Company, Inc., Providence 1, R. I. Warehouses: Atlanta • Buffalo • Charlotte • Chicago • Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach Los Angeles • Milwaukee • Minneapolis • New York • Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

This picture was taken in the Bridgeport office of The Southern New England Telephone Company, one of the 22 operating telephone companies which the Laboratories serve through the Bell System.

Cutting Board for Telephone Costs

Few of these tools have sharp edges. But they are powerful cost cutters. Whenever a telephone craftsman reaches for one, he finds the right tool ready to his hand. There's no time wasted trying to do a complicated job with makeshift equipment.

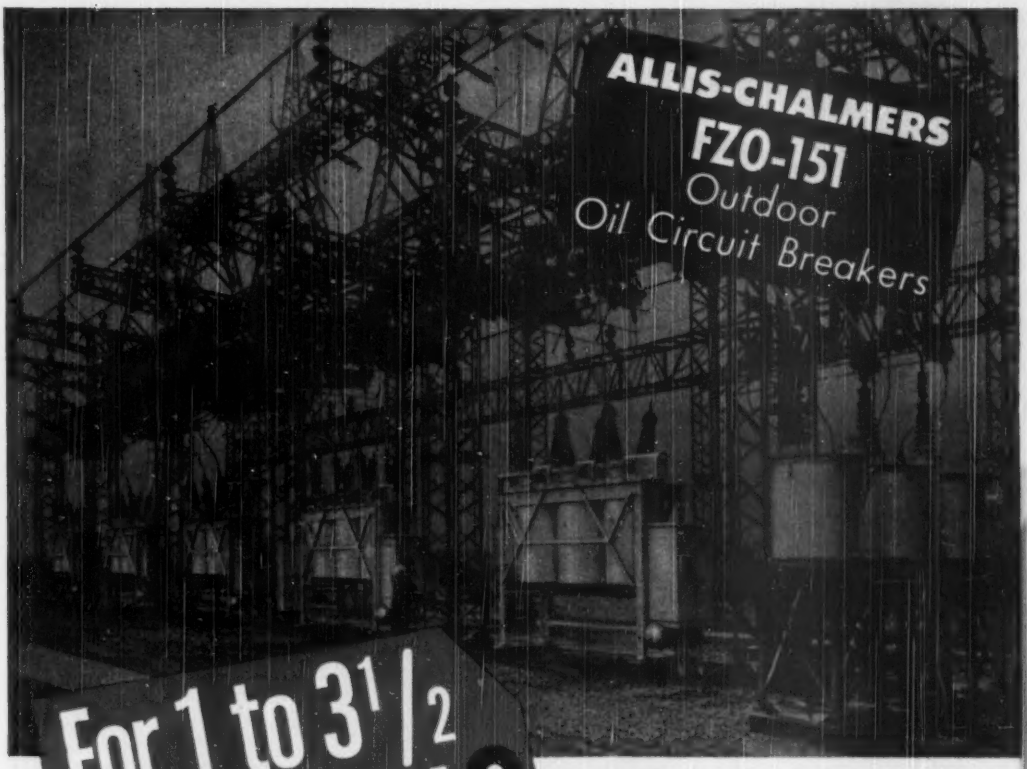
Most telephone tools are highly specialized. 90% of dial system tools were designed by Bell Laboratories. Each saves time in maintenance, installation or construction.

There are tools with lights and mirrors to work deep within relay bays; tools to brush, burnish and polish; tools that vacuum clean—even a tool to weld on new contact points without dismantling a relay. There are gauges to time dial speeds, others to check spring tension. Some look like a dentist's instruments. Some you have never seen.

Keeping the telephone tool kit abreast of improvements is a continuing job for Bell Telephone Laboratories. It's another example of how the Laboratories help keep the value of your telephone service high, the cost low.

BELL TELEPHONE LABORATORIES

WORKING CONTINUALLY TO KEEP YOUR TELEPHONE SERVICE BIG IN VALUE AND LOW IN COST



- **MECHANICALLY TRIP-FREE PNEUMATIC OPERATOR** *assures positive tripping*
- **SINGLE-BREAK *RUPTOR* DEVICE** *(5 cycle interruption if required) for low arc energy release*
- **EVERY BREAKER** *factory assembled, tested, and shipped without dismantling.*

INSTANT, POSITIVE CONTACT OPENING under all conditions is *assured* with FZO-151 breakers. The reason is Allis-Chalmers mechanically trip-free pneumatic operator. In case of a fault, the operator is effectively uncoupled from contact mechanism by means of a positive mechanical linkage. Contacts open *independent of valve operation or cylinder back pressures* . . . there's nothing to hinder instant tripping.

Positive operation is further assured with simple, single-break *Ruptor* interrupting device that extinguishes arc without use of unnecessary moving parts that may bind or fail. Self-cleaning action of bayonet-type moving contacts prevents formation of high resistance oxides. Low inertia pole unit mechanism of straight line motion type gives high speed interruption with low arc energy release.

Complete factory test data accompanies every breaker. For details on Allis-Chalmers breakers for any utility need, contact your A-C sales office,

ALLIS-CHALMERS, 932A SO. 70 ST. MILWAUKEE, WIS.

STANDARD RATINGS
(8 cycle interruption)

Rated KV	Rated amp. 60 cycle	KVA Interrupting Capacity
69	600	1,000,000
69	1200	1,500,000
69	1200	2,500,000
69	2000	3,500,000

GET NEW BULLETIN
71B7045 for ratings, dimensions and details of construction of type FZO-151 breakers.

A-3073

Ruptor is an Allis-Chalmers trademark

ALLIS-CHALMERS

Approved by UNDERWRITERS LABORATORIES

YES, the PENN-UNION Connector TAKES THEM ALL-

LARGER SURFACES for the WRENCHES ~ a good-sized HEX Top and Bottom

The men who use connectors appreciate the *better design* of the Penn-Union - - especially when they have to make a splice in close quarters, or any unhandy location.

Better Design is a feature of the entire Penn-Union line, which includes Tees and Taps, Straight Connectors, Terminals, Grounding Clamps, and many more fittings . . . every one thoroughly dependable, mechanically and electrically. *Preferred by leading users,* who have found that "Penn-Union" on a fitting is their best guarantee of unfailing service.

Far More in use than any other

Sold by Leading Wholesalers

PENN-UNION ELECTRIC CORPORATION, Erie, Pa.

Canada: Dominion Cutout Company, Ltd., 250 Richmond St. West, Toronto

The Complete Line of Conductor Fittings

PENN-UNION

PROVED PERFORMANCE HIGH SPEED PROTECTION CORROSION RESISTANCE

Ventilated Spark Gaps Plus Transparent Housing Assures Easier Inspection, Efficient Protection

Here's the heavy duty lightning arrester that's been proved on the job in thousands of installations under all conditions . . . available in ratings of 6.0—9.0—12.0 and 15.0 KV. During their 16 years of operation they have established practically 100% performance records from the standpoints of protection, freedom from gap corrosion due to moisture, radio interference and arrester failure.

GLASS BODY FOR EASY INSPECTION OF GAPS

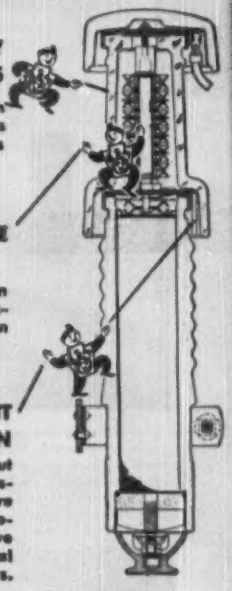
Condition of spark gaps readily seen at all times without removing arresters for testing. Safer protection . . . less labor required for maintenance.

HIGH SPEED MULTIPLE ARCING UNIT

Assures long life, split second action with maximum protection to the transformer and a minimum of stress on its insulation.

VENT OPENINGS TO PREVENT MOISTURE ACCUMULATION

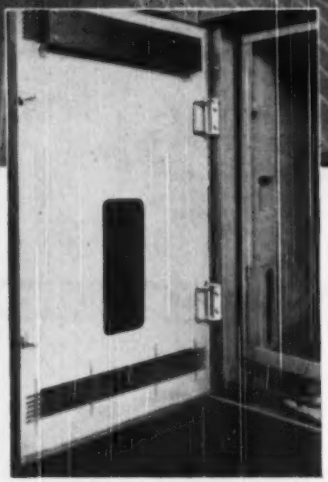
Permits free access of air in and out of spark gap housing. Interior of housing kept dry. Spark gap elements are not subject to deterioration or corrosion from moisture. Ask for descriptive information and prices on these Crystal Valve Ventilated Spark Gap Arresters.



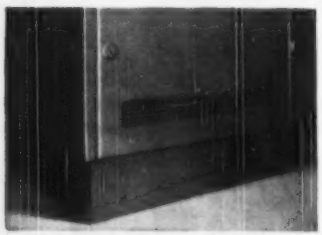
ELECTRIC SERVICE MANUFACTURING CO. • 1709 Cambria St. • Philadelphia 32, Penna.

CRYSTAL VALVE
LIGHTNING ARRESTERS

Photograph — Courtesy Falls City Brewing Co., Louisville,



All panels and doors are full-formed sheet steel. Corners are turned and welded for greater rigidity. All hinges are concealed by being mounted *inside* the enclosure. Effective grilled louvers contribute to the smooth, neat appearance of the switchboard.



Practical and attractive sturdy channel base can be bolted to the floor, or it can be inset either part-way or flush with the floor surface. Formed top trim and end panels complete the elimination of dangerous and unsightly raw metal edges.

MULTUMITE SWITCHGEAR IS ATTRACTIVE!

Note the compactness and beauty in the construction of the typical Multumite assembly above. With the exception of the breaker-operating handles and the semi-flush instruments, the exterior of the board presents a flat surface from top to base. All parts of the enclosure are full-formed from sheet steel—there are no raw metal edges. Grilled louvers and easy-to-adjust door hinges are hidden inside, adding to the pleasing appearance of the board.

The exterior finish of Multumite switchgear is an oven-baked synthetic enamel—bonderized to the metal to guarantee a permanently attractive surface.

GET THESE DESCRIPTIVE BULLETINS:

6003-D A complete reference guide to I-T-E 600 V Switchgear assemblies. Contains dimension information on I-T-E Multumite, and helpful facts for specifying and ordering complete switchgear installations.

7000-A Describes I-T-E's newest 5 KV Switchgear—is illustrated and supplemented with practical, easy-to-read drawings and diagrams. If you have any questions on modern HV switchgear construction, it will pay you to have this bulletin.

Get both bulletins—ask your local I-T-E Representative, or write I-T-E General Offices.

get Extra Protection— SPECIFY I-T-E MULTUMITE SWITCHGEAR!

I-T-E Multumite Switchgear is specially designed to provide the *extra margin of safety* so necessary to uninterrupted service of electrical circuits. Metal-enclosed Multumite Switchgear assures positive protection of secondary distribution systems. *Here are some reasons why:*

1. Breaker's metal panel separates bus and breaker compartment, seals off ionized gases.

2. Silver-plated buses and connections eliminate progressive oxidization, minimize temperature rise.

3. Easy accessibility of breakers and bus compartments facilitates inspection and maintenance.

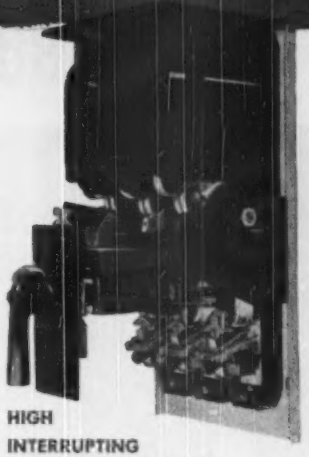
4. Enclosure of control wiring in metal troughs provides a new degree of safety and protection.

5. Specially designed arc chutes quench arcs *quickly* and dependably, *in air.*

6. Breakers are mechanically and electrically trip-free.

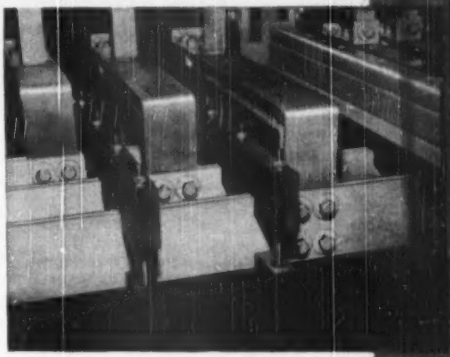
These examples of extra quality—extra protection built into I-T-E Switchgear are typical. Investigate the others.

All I-T-E Switchgear assemblies offer the benefits of an application planned for your specific needs, with units coordinated for most effective protection. Quick, easy installation is assured. *Complete* assembly is tested *before* shipment. Quality is fully guaranteed.



HIGH INTERRUPTING CAPACITY BREAKERS

TYPE KB Breaker. 25,000 RMS Amp. Interrupting Rating. 600 Amp. Continuous Rating. 2, 3, or 4 Poles. Manually or electrically operated.



IDEAL BUS ARRANGEMENT

MULTUMITE BUS is arranged for adequate electrical clearance. Strong bracing with sturdy insulating supports assures withstanding maximum short circuit stresses. Bolted connections provide solid contact and rigidity.

I-T-E

R&IE

For *more dependable* Switchgear

specify I-T-E!

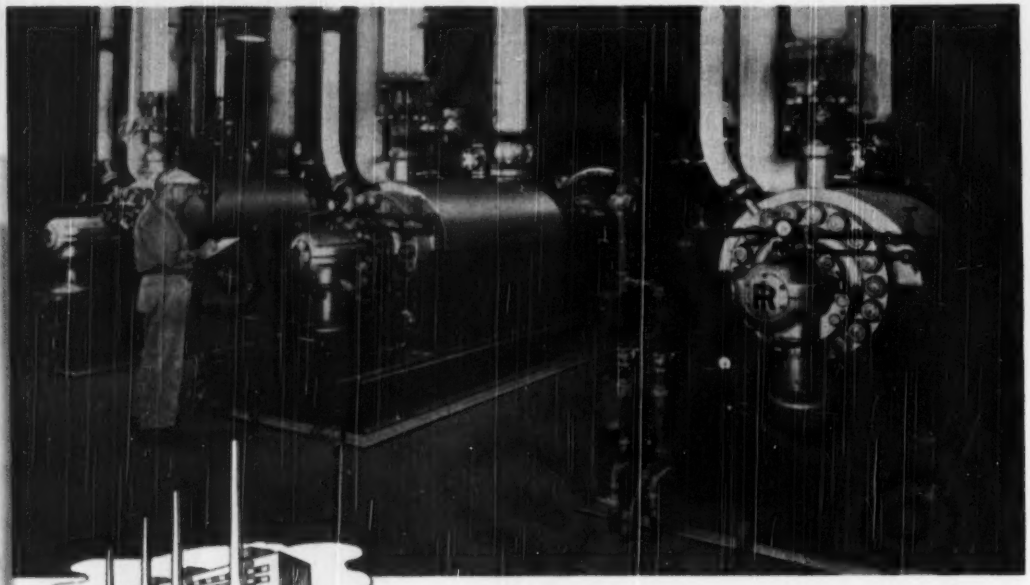
I-T-E Circuit Breaker Company • 19th & Hamilton Streets • Philadelphia 30, Pa.

Power Switching Equipment: Railway and Industrial Engineering Co., Greensburg, Pa.

Canadian Mfg. & Sales: Eastern Power Devices, Ltd., Toronto • Export Sales: Philips Export Corp., New York

SWITCHGEAR • UNIT SUBSTATIONS • ISOLATED PHASE BUS STRUCTURES • CIRCUIT BREAKERS • MECHANICAL RECTIFIERS RESISTORS • SPECIAL PRODUCTS

NEW PHILIP SPORN STATION TO INSTALL 24,000 HP OF I-R BOILER-FEED PUMPS



Twelve Ingersoll-Rand "double case" pumps, operating at 2395 psi, will handle all boiler-feed water for the four 150,000 kw units

This new high-pressure steam generating plant, named in honor of Philip Sporn, president of the American Gas and Electric Company, will serve the company's vast interconnected system in the seven states of Michigan, Indiana, Ohio, Virginia, West Virginia, Kentucky, and Tennessee. Designed by and constructed under supervision of the American Gas and Electric Service Corporation, it will eventually make available 900,000 kw of net output capability to meet the system's rapidly increasing demands for electric power.

The new Philip Sporn Station of the American Gas and Electric Company System, near New Haven, West Virginia, represents the last word in steam plant design. The first generating unit with a net output capability of 150,000 kw, went into commercial operation in January 1950. Three additional units, which are already under construction, will bring the plant net output capability to 600,000 kw.

Each of these four generating units will be served by three Ingersoll-Rand Class CHTA, 11-stage, "double case" pumps—two for full load requirements, and the third for stand-by service. Three of these feed pumps are shown above, direct connected to 2000 hp, 3570 rpm motors. Each pump is designed to handle 1100 gallons per minute, at 2395 psi and 304° F.

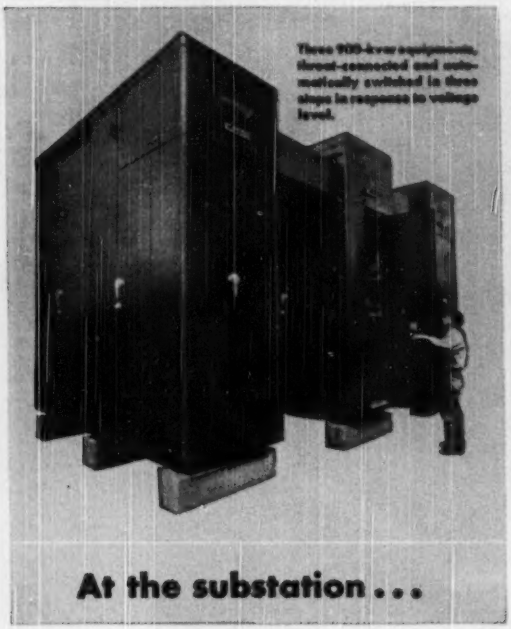
Here, as in all high-pressure steam plants, the accent is on *dependability and continuity of service*. And Ingersoll-Rand boiler-feed pumps have repeatedly proved their ability to stay on the job year after year under the most severe operation conditions. That's why they're *first choice* for really high pressure service.

PUMPS • COMPRESSORS
AIR AND ELECTRIC TOOLS
DIESEL ENGINES • ROCK DRILLS
VACUUM EQUIPMENT • CONDENSERS

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y. 537-10

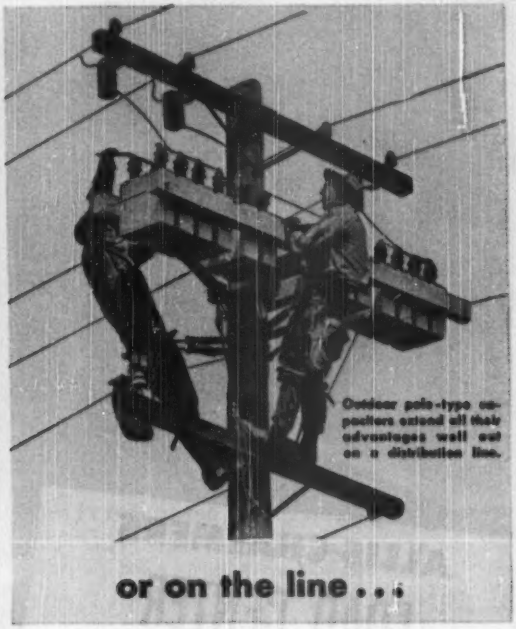
YOU CAN BE **SURE**.. IF IT'S

Westinghouse



Three 900-kvar equipments, throat-connected and automatically switched in three steps in response to voltage level.

At the substation . . .



Outdoor pole-type capacitors extend all their advantages well out on a distribution line.

or on the line . . .

Make way for the Payload!

Capacitors provide the lowest-cost method of gaining extra circuit capacity . . . and now cost less than ever before . . . in some ratings as low as $3.60 per kvar. So, *now* is the time to make way for the payload . . . to release wasted circuit capacity for more kilowatts. And in the complete line of Westinghouse Inerteen Capacitors, you'll find the right equipment for the job.

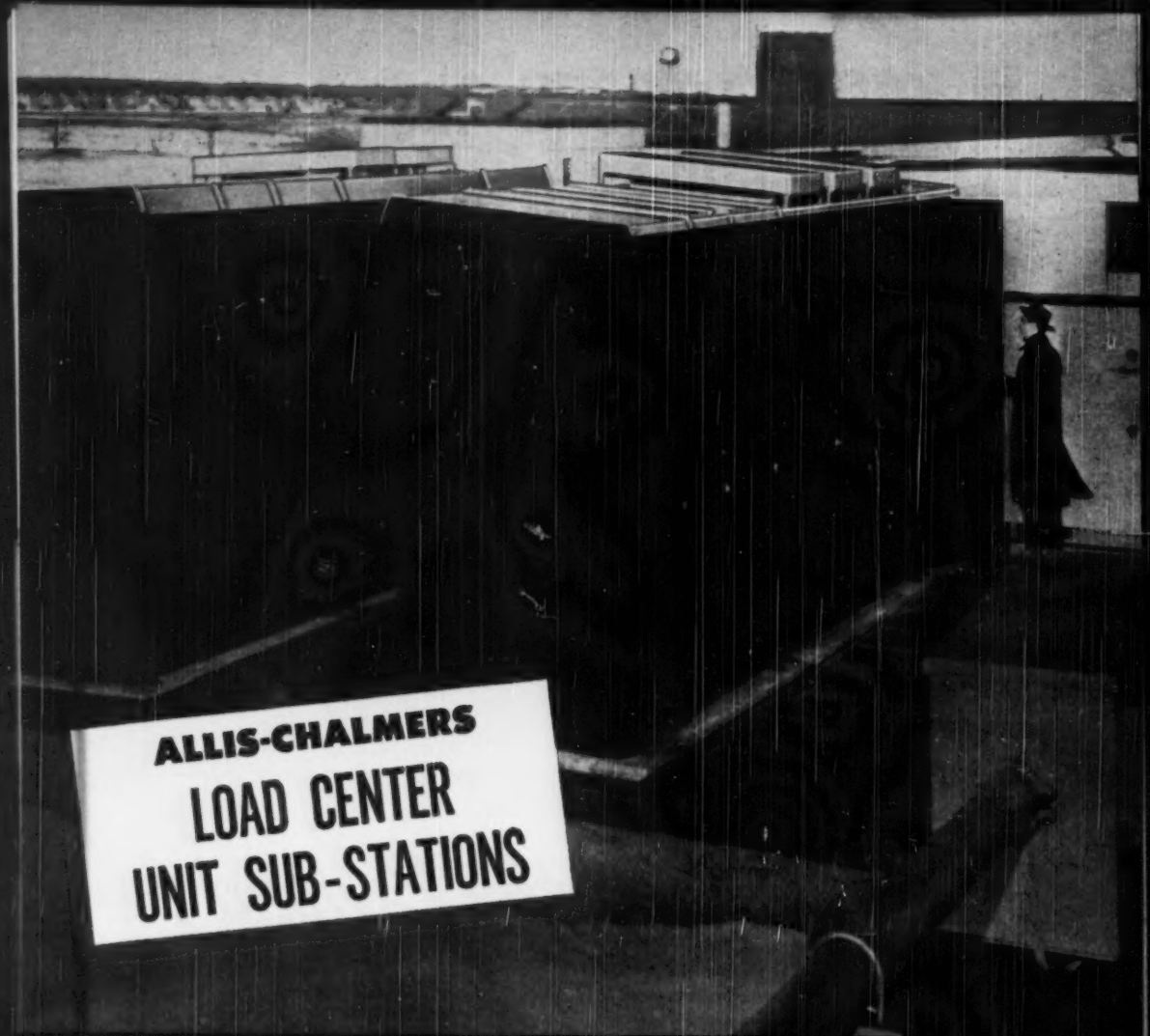
From individual unit installations on primary distribution lines, to completely housed equipments for substation banks you can be *sure* of better performance with Westinghouse Capacitors—whether the application be power-factor correction, voltage control or reducing line and equipment losses. But, for any application, check first with Westinghouse.

Our years of close co-operation with utilities have given us broad experience in applying capacitors to many conditions. We'd like to apply it to your problem.

For complete information call your local Westinghouse office, or write for Booklet B-4343. Address: Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-60717

GET THESE TIME-PROVED FEATURES

- **Inertex Insulating Paper**
- **Inerteen Impregnation**
- **Solder-Sealed Porcelain Bushings**
- **Durable, All-Welded Steel Cases**
- **Weatherproof Zinc-Spray Finish**



ALLIS-CHALMERS

LOAD CENTER UNIT SUB-STATIONS

ALLIS-

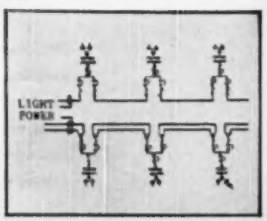
Pioneers in Load Ratio

THE REQUIREMENT:

Service demands required a distribution system with tie connections to assure continuity of power under emergency conditions. This complicated selection of proper breaker sizes, relay settings and tie line locations.

THE ANSWER:

Several possible systems, any of which would meet requirements, were set-up on the calculating board for analysis. This study determined selection of the proper relay settings, transformer and breaker sizes.



Number 2
In a Series
Solving Industrial Power
Distribution Problems.

Calculating Board Replaces Guesswork with Facts!

SPECIFIC, DEFINITE ANSWERS — not estimates — were urgently required when a prominent mid-western manufacturer was suddenly faced with a major expansion problem involving his complicated distribution system. Allis-Chalmers was called in.

A-C engineers carefully examined the requirements . . . then set up the existing system — plus the proposed expansion — on a calculating board. Load currents and voltage regulation at critical points as well as short-circuit magnitudes and proper relay settings were determined. Guess work was eliminated — facts replaced estimates! The solution was completely satisfactory . . . so satisfactory that more and more Allis-Chalmers Substations are being added as the plant expands.

Call in A-C at the Basic Planning Stage

Allis-Chalmers engineering experience, backed up by calculating board studies where necessary, can help in solving your distribution problem. And the time to call on this experience is during basic planning, early enough for sound equipment recommendations. An A-C representative is ready to go to work with you at your convenience. Get in touch with him at your nearby A-C Sales Office, or write direct.

A-2958

ALLIS-CHALMERS, 932A SO. 70 ST.
MILWAUKEE, WIS.

A-C CHALMERS

A-C ALLIS CHALMERS

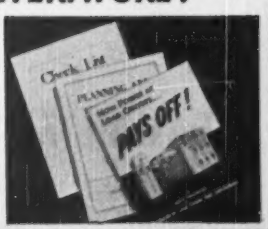
Control — Originators of 5/8% Step Regulation

PLUS LOCATION PROBLEM:

Space limitations made a roof location necessary . . . but oil and non-inflammable liquid filled transformers were ruled out. No other type was available. A-C designed and built outdoor dry-type substations — the *first* of this kind.

SEND FOR LITERATURE:

Bulletin 11B6285A, "How Power at Load Centers Pays Off!", bulletin 11B6525B, "Check List to Simplify Unit Substation Planning," bulletin 11B6895, "Planning and Engineering Guidebook for LCS Unit Substations."



Cables run COOLER...
in TRANSITE DUCTS

. . . reducing copper losses
. . . increasing current capacity
. . . prolonging insulation life

YOU REDUCE copper losses . . . increase current carrying capacity . . . and prolong insulation life, when you run your cables in Transite* Ducts.

Current carrying capacities can be increased in a typical duct bank as much as 5%, or I^2R losses can be reduced 11%, for cables located in Transite as compared with other ducts used for power circuits.

And, Transite Ducts assure permanent duct banks because Transite is incombustible; is immune to rust and rot; is unaffected by electrolysis; will not slag under action of an arc, and will retain its high original strength.

An unusually smooth bore assures no injury to cable sheath, either in natural movement under load, or when pulling-in cables. Long, lightweight lengths can be quickly and economically installed. In addition, a full line of fittings simplifies even the most complicated of installations.

For full information on Transite Ducts, write for Data Book DS-410. Johns-Manville, Box 290, New York 16, N. Y.

JM

*Reg. U. S. Pat. Off.

How Transite Ducts increase current carrying capacities

Type cable 3 cdr. 500 MCM Compack Sector, 15 KV (6th Edition AEIC Spec.)
No. of cables—3 (all loaded in one bank)
Daily Load Factor—75%
Earth Temp. ambient—20 C

	Transite	Other
Total Therm. Res. to Dielectric Loss (C watts/ft.)	3.66	6.17
Total Therm. Res. to Copper Loss (C watts/ft.)	4.44	4.93
Temp. Rise from Dielectric loss (C)	1.9	2.1
Allowable Rise for Copper loss (C)	59.1	58.9
Allowable Watts per ft. cable	4.44	3.96
Allowable Current—(Amps. per cdr.)	386.	365.
Allowable Current—(Relative %)	105.6	100.

Johns-Manville *Transite Ducts*

TRANSITE KORDUCT—for installation in concrete

TRANSITE CONDUIT—for exposed work and installation underground without a concrete encasement

You get the
ADDITIONAL PROTECTION
and **SAVE 22%**

Install the

KEARNEY QRC

For 22% less than the minimum cost of a pole-top mounted arrester and fuse cutout installation, you get both lightning protection and overcurrent protection in the Kearney QRC, a station arrester-fuse cutout combination.

Both units, on one insulator, cost only $2.94 more than you would pay for the arrester... and you save ½ the installation cost!

See Following Pages for Protection Features

JAMES R. KEARNEY CORPORATION
4224-42 Clayton Avenue
St. Louis 10, Missouri
Canadian Plant: Guelph, Ontario

HOLD LINE CONSTRUCTION COSTS TO A MINIMUM
Check
THESE ADVANCED DESIGN FEATURES:
1
2
3
SPECIFY KEARNEY PRODUCTS

Install The KEARNEY QRC

COMBINATION LIGHTNING ARRESTER and FUSE CUTOUT

Kearney Combined Protection for your conventional transformer is today's solution to the problem of getting the most out of your investment . . . providing more and better service with engineered economy. Initial cost is less, installation and maintenance costs are minimized . . . and your transformer is completely protected.

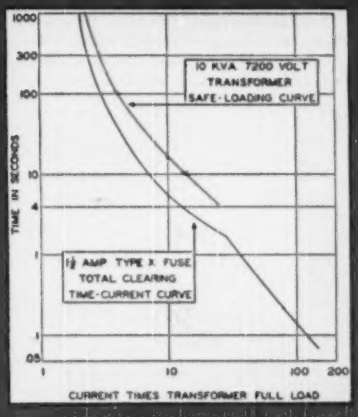
The QR arrester employed in Kearney QRC Combined Protection units provides low sparkover action for insulation security, high surge capacity for long life, and the unrestricted expulsion chamber construction assures quick, complete interruption of follow current.

The convenience and economy of the Trip-C-Link fuse cutout is your further assurance of complete protection with maximum economy.

FOR TRANSFORMER PROTECTION

The KEARNEY Type X FUSE LINK

Gives You OVERLOAD PROTECTION plus HIGH SURGE CAPACITY



Protection of service continuity is an added advantage of the QRC when you fuse with the Type X link. Compare the time-current curve of the 1½ ampere Type X fuse (B) with the safe loading curve (A) of a 10 KVA, 7200 volt transformer. This extra protection gained for long duration overcurrents is accomplished at no sacrifice of surge capacity . . . assurance against unnecessary outages due to switching surges and other non-damaging transients.

Write for complete information on the QRC, characteristics of the QR arrester and the Type X fuse link.

JAMES R. KEARNEY CORPORATION
4214-42 Clayton Avenue St. Louis 10, Missouri
Canadian Plant: Guelph, Ontario

JAMES R. KEARNEY CORPORATION ST. LOUIS, MO.

Better Construction—SAFER Maintenance

AT PHILIP SPORN PLANT*:

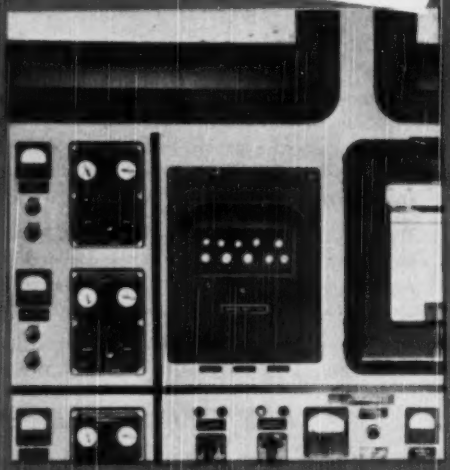
Diamond "Utiliscopes" Increase Safety and Operating Efficiency

TELEVISION IN INDUSTRY

At Philip Sporn Plant two Diamond "Utiliscopes" (wired television) enable the control room operator to see for himself the exact boiler water level . . . and the condition of the 10 burner pilots in the furnace. One "Utiliscope" camera watches boiler water level; the image of the gage shows on the viewing screen which is a part of the control panel. Viewports, which show whether burner pilots are on or off, are observed by another "Utiliscope" camera through a system of mirrors; the viewing screen on the control panel shows them as a series of 10 bright discs when all are lighted.

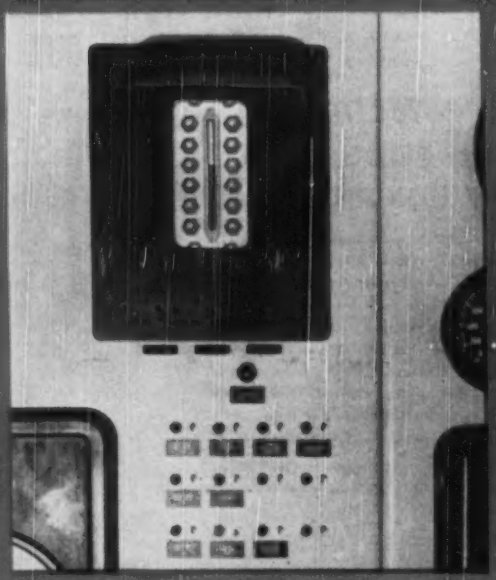
The "Utiliscope" is solving many problems in power plants and countless other places in industry. Whenever anything is too remote, too inaccessible, or too dangerous to observe directly, the "Utiliscope" is the answer. Ask for Bulletin 1025.

*Part of the American Gas and Electric Company System.



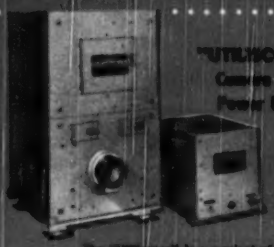
CHECKING PILOT BURNER FLAME CONDITIONS

A "Utiliscope" camera watches the 10 burner pilot viewports through a system of mirrors. They show on the viewing screen (which is built into control panel) as 10 bright discs. Pattern is regular, so absence of one or more discs is detected at once without counting.



READING BOILER DRUM WATER LEVEL

The "Utiliscope" camera watches a Diamond Bi-Color Water Gauge. As indicated above, the control panel viewing screen shows a clear light and dark image which indicates water level exactly . . . changes instantly as water level changes. The "Utiliscope" provides the correct reading or no reading . . . it cannot give incorrect information.



"UTILISCOPE" Camera and Power Unit

The "Utiliscope" is a product of the Constant-Fram-werk Corporation and the Diamond Power Specialty Corp. • "Utiliscope"—Registered U.S. Patent Office.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited • Windsor, Ontario

AT PHILIP SPORN PLANT*:

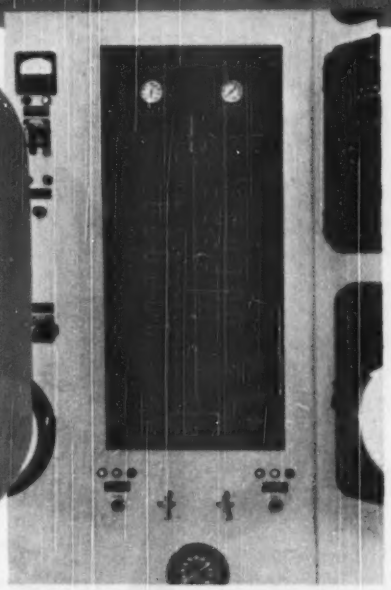
DIAMOND AUTOMATIC SEQUENTIAL SOOT BLOWING SYSTEM provides correct cleaning at minimum cost

The "human element" is eliminated from boiler cleaning by the Diamond Automatic Sequential Soot Blowing System. All blowers operate in proper sequence and at correct blowing speed every time . . . no blower can be overlooked or incorrectly operated by a careless operator. In addition to improved cleaning, there is a saving in labor as an attendant is not required by automatic operation.

At Philip Sporn Plant, Diamond Soot Blowers of various types are used according to furnace location and service required. All blowers are controlled by the control panel shown at the right. To do the complete blowing job the control room operator merely moves a lever. The control panel takes over . . . operates each blower or group of blowers correctly and in turn. On completion of the blowing cycle the panel automatically shuts off. For further information on the many advantages of Diamond Automatic Sequential Soot Blowing Systems, ask for Catalog 1014.

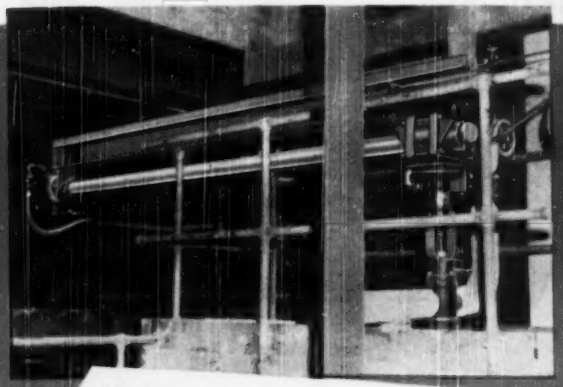
DIAMOND AUTOMATIC SEQUENTIAL AIR CONTROL PANEL

Controls automatic cleaning cycle of any arrangement of the various types of blowers. Operator starts cycle simply by moving start and stop valve carrier to the down position. Traveling upward, it operates each selected unit or group in turn and shuts off when all cleaning cycles are completed. Shows at a glance the unit in operation and those that have operated. No electrical connections of any kind.

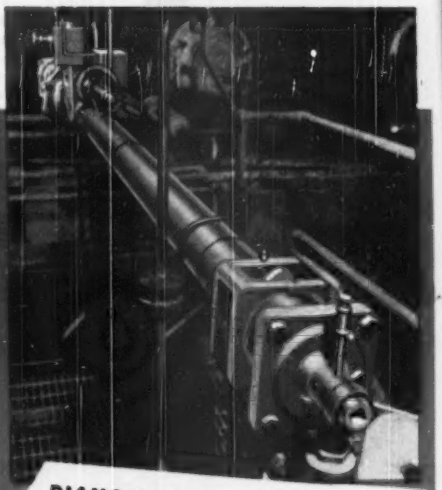


*Part of the American Gas and Electric Company System.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited • Windsor, Ontario



DIAMOND MODEL IK LONG RETRACTING SOOT BLOWERS



DIAMOND TELESCOPIC LONG RETRACTING SOOT BLOWERS

Every HOT wire

ANACONDA "POWER UP" CAMPAIGN helps utilities
Here is another advertisement in Anaconda's "POWER UP—And Be Prepared" campaign urging industry to make more efficient use of the electric power it buys from you. These Anaconda messages are also going to contractors and wholesalers.
As in our previous industry-wide campaigns, we again offer advertisement reprints, imprinted with your letterhead and message —for mailing to your industrial power customers.

The right cable for the job

costs you cold cash

It's 9 to 1 your wiring is overloaded!

IT'S TRUE! Actually 9 out of 10 plants, today, are suffering power loss and profit loss because of overloaded wiring.
Chances are it is happening to you!

PRODUCTION SLOW-DOWNS, lost man-hours, electrical leaks through over-heating are all results of poor plant wiring . . . wiring that just can't deliver the power you pay for—day in, day out.

POWER UP—And Be Prepared before a breakdown occurs, before inadequate wiring blocks expansion. Call on your consulting, utility, plant power engineer, or electrical contractor for a complete check-up.

AND, MOST IMPORTANT OF ALL, write for your free copy of *POWER UP—And Be Prepared!* This complete guide to wiring will show you how simple alterations now will save you money every day—and huge repair bills later!

Anaconda Wire & Cable Company,
25 Broadway, New York 4, N. Y.

FREE! A complete guide to plant wiring and maintenance.

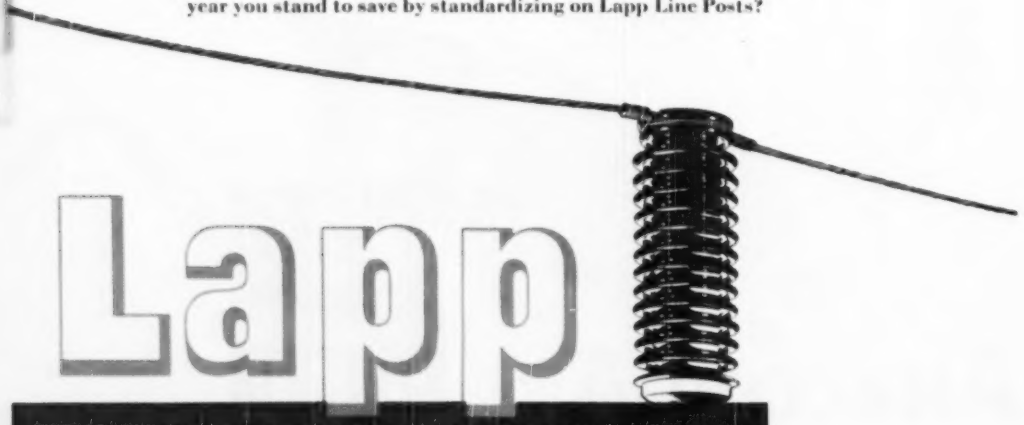
ANACONDA
WIRE AND CABLE

Why Not Shock Yourself?

● If you're like most engineers responsible for the operation of transmission lines, you've probably largely lost track in recent years of insulator performance records. It seems rather popular these days to assume that high-voltage insulators are generally "All right." So usually there's a rude shock waiting for any engineer or executive who goes to the trouble of actually finding out what the annual cost for transmission insulator maintenance in his company really adds up to. Those costs do go on, because there's little about conventional transmission insulators today that make them much better than they were 20 years ago, when practically all companies kept a sharp eye on maintenance costs.

But there's one notable exception to all this. The Lapp Line Post. This advanced insulator design now has a 19-year service record. On line after line, all across the country, it has proved its ability to cut insulator maintenance cost to a tiny fraction of that run up by pin-type insulators.

A careful analysis of your own service records will show you the facts. Isn't it worth it for the thousands of dollars per year you stand to save by standardizing on Lapp Line Posts?

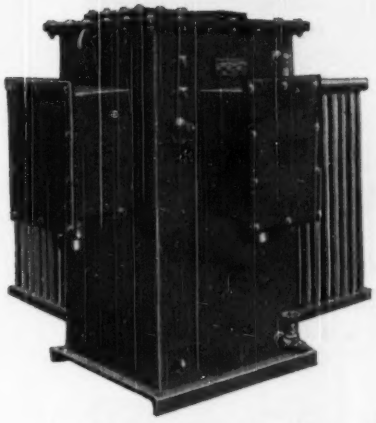


Lapp

LAPP INSULATOR COMPANY INC., LEROY, NEW YORK

DISTRIBUTION

The Dependability you demand, in the types and sizes you need.

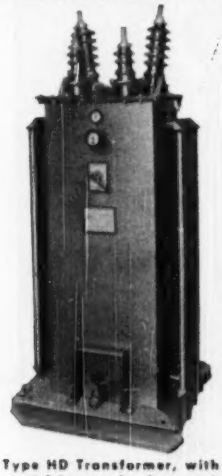


Large Uptegraff Distribution Transformer, with radiators and enclosed junction boxes. Askarel immersed.

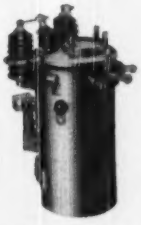
Long life and dependability are built into Uptegraff Distribution Transformers through sound design and rugged construction. Available in sizes from 1½ to 500 KVA, up to and including the 69 KV Class. Types include air-cooled dry types, as well as oil or askarel immersed transformers. The units shown here are representative of Uptegraff designs.

Uptegraff is well-equipped to promptly serve individual specialized needs as to capacity, rating and dimensions. We will be glad to have our nearest representative call at your convenience, to discuss your transformer problems.

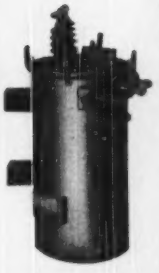
Large air-cooled distribution transformer, for indoor service.



Type HD Transformer, with special base and valve guard.



Above—25 KVA self-protecting, pole-mounted transformer. Right—Distribution transformer with cover-mounted high voltage bushings.



R. E. UPTEGRAFF

YOU CAN BE SURE.. IF IT'S
Westinghouse

Neat Case...

for Residential Distribution

Underground!

It's a neat case that covers the new Westinghouse Semi-Buried Distribution Transformers for modern residential areas.

Because they eliminate the need for unsightly poles, they help you get all the advantages of underground distribution . . . at a cost far below subway-type installations. Easily and inexpensively camouflaged, they enhance real estate values, create good will.

The steel housing locks securely in place on a concrete base that supports the transformer partially below ground level. It can be removed quickly to provide access to terminals. Ventilating grilles and baffles assure adequate cooling, guard against tampering.

Heart of the unit is the Westinghouse Distribution Transformer ("CSP"® or Conventional). This design handles residential services using transformers 50 kva and below. For further information, contact your Westinghouse representative or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-70552

Westinghouse

DISTRIBUTION TRANSFORMERS

CAA APPROVED CABLES

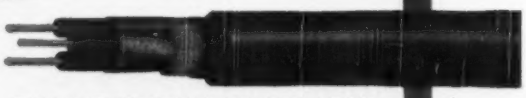
Approved under specification L-824

Now that the CAA's airport lighting program has been given the "green light," there's a *sure* way to meet the rigid requirements of Civil Aeronautics Authority Specification L-824, "Underground Electrical Cables for Airport Lighting." *Specify National Electric Style RR Flexlay Cables!*

NE Flexlay Cables are *dependable* for the continuous service conditions required by airports. Designed for underground installation—either direct burial in the earth or pulled in conduits—these cables have plenty of "abuse resistance" built-in. The tough, specially-compounded Neoprene sheath affords complete protection against the destructive forces below the earth's surface, as well as sun and weather.

NE CAA-approved cables are recommended not only for airport lighting and signal circuits, but for street and highway lighting, municipal, power and other installations—indeed wherever *reliability counts the most.*

You're sure of safe, dependable operations when you specify National Electric CAA-approved cables in your next airport installation.

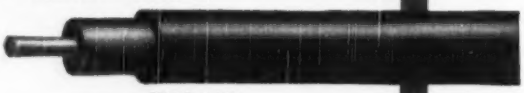


TYPE "A" PERFORMANCE INSULATION

Flexlay Cable, Style RR, Airport Lighting Cable, 600 Volt Rating, AWG Sizes 4 through 16. (Single and Multiple conductor available)

TYPE "B" OZONE RESISTANT INSULATION

Flexlay Cable, Style RR, Airport Lighting Cable, 3000 Volt Rating, AWG Sizes 4 through 10. (Single and Multiple conductor available)



TYPE "B" OZONE RESISTANT INSULATION

Flexlay Cable, Style RR, Airport Lighting Cable, 5000 Volt Rating, AWG Sizes 4 through 8. (Single Conductor)

Light in weight—Flexible
Easy to handle

EVERYTHING IN WIRING POINTS TO

National Electric
PRODUCTS CORPORATION

1305 CHAMBER OF COMMERCE BUILDING, PITTSBURGH 19, PA.

New Frontier on the Ohio

THE OHIO RIVER, which played so stirring a part in the opening up and development of America in the nineteenth century, has long since passed the era of the advancing frontier. Yet, a new frontier has actually been opened on the Ohio within the past few months. Its implications are so immense that this entire issue is dedicated to the event. This new frontier is a technological one, and it came about with the successful opening of the Philip Sporn Plant—a new milestone in the development of large-scale economical generation of electric energy by steam-electric methods.

The new technical and economic features of this project are numerous and striking as indicated by the summary on the following page and the series of articles carried in this issue of ELECTRICAL WORLD. Impressive as are the size of the boiler, the throttle temperature and pressure adopted, and the further development of the reheat cycle, other features of the plant are even more noteworthy. For in these days of monumental and ever-growing federal projects, the completion of this undertaking effectively demonstrates the ability of private capital to conceive, undertake, and carry through large-scale developments. Here is a power plant conceived as an entity to develop 900,000 kw and whose first step carries it two-thirds along the way to completion. When the project is completed, it will have a capability of generating 6 to 6½ billion kwhr per year, a figure almost a billion kilowatt hours in excess of the annual generation at Hoover Dam in an average year and equal to 40% of that produced by the Tennessee Valley Authority in 1949 in its score or so of plants.

The performance bogey of 9,300 Btu per kwhr to feeders—0.715 lb of coal per kwhr—is another striking feature of this development. This new standard of efficiency in the conversion of fuel to electric energy has implications of enormous scope from the standpoint of conservation of resources and national defense.

Even more noteworthy is the fact that this result was not achieved by any revolutionary overnight developments but is the product of a continuous and persistent program of research and development carried out by the utilities and the manufacturers operating as part of the American free enterprise system. No government initiated aid or encouragement, moral or economic; brought it about; or had a hand in it.

The record of the American power industry is that it has done a magnificent job in placing the United States in the forefront of power development in the civilized world and a great job not only in meeting the enormously expanded postwar requirements for power but in actually stimulating and advancing them. The industry has not always been given due credit for that performance. Doubt has of late been raised in some quarters even as to the industry's ability to meet its responsibilities in a future emergency. We believe it will, if it is not harassed too much, do an even better job in the future than in the past. But it is very important that the utilities better themselves and display the same vision, courage, originality, and enterprise in carrying out their other affairs as they have demonstrated in the technical-economic field. If opportunities for such action have been lost in the past, is there any reason why they should be missed in the future?

Highlights of Sporn Plant

- High economy large-scale generation
- Single 1½ billion Btu 930,000 lb-per-hr boiler
- Pressure 2,000 psi, 1,050/1,000 F reheat
- 1,000 F on 1,800 rpm element of cross-compound turbine
- Seven extractions
- Compression evaporation, complete deaeration
- Control concentrations functionally divided
- Remote control of starting, including burner ignition
- Recirculation of combustion gases for steam temperature control
- Turbine stop valves also serve boiler
- Bored forging for steam header
- Weir in discharge tunnel saves foundation cost
- Short direct leads to well-placed electrical equipment
- Switching held to minimum to reduce costs and minimize operating errors
- Plant cubage held to 26 cu ft per kw overall
- Conveyor connects coal mine, dock, storage pile
- Overall thermal eminence without excessive cost in outlay, upkeep or labor

Speaking Their Language

REALIZATION of the necessity for the technical man to speak the "language" of the non-technical people with whom he works has gained increasing acceptance in the electric utility industry. That's why the industry displays so much interest in interpretive publications like *Simplified Electricity for Utility Workers*, by P. R. Rutledge of Central Hudson Gas & Electric Corp.

Simplified Electricity, a ring-bound collection of 10 brief study courses, does a masterful job of explaining in brief, simple language the basic principles of system operations. It shuns none of the elementary theory. It simply translates polysyllabic engineering terms, and even some formulae, into words and phrases understood by the "natives" in utility clerical and other non-technical departments.

It's not so surprising that the author has received inquiries from more than 200 utilities. The industry too long has suffered from the lack of understanding among its own employees. Most of its leaders now understand that employee education is a vital preliminary to better public relations.

But power companies could well make better use of *Simplified Electricity* than they would by simply making it available to non-technical employees. Executives, especially those from legal and financial departments, probably would benefit as much by exposure to such information. And the engineers, who presumably are quite familiar with the facts covered, could study with profit the technique of explaining their own work in terms understandable to the man in the street. The industry has need of every articulate spokesman it can muster.

Turn the Salesmen Loose

SALESMEN make their livings by selling. Naturally they are all for it. Sales executives are salesmen, or should be. If they are not, the signs on their office doors should be changed, or maybe themselves in some cases. But let's leave that to lie as it falls. Let's agree that sales executives are salesmen full of enthusiasm for their jobs.

An office a few doors down the hall from the large and airy room where sits the president of the power company is inhabited by one of these authentic sales executives. Every few days he bursts out of his office, races along the hall, brushes past the president's secretary, and starts his old familiar song.

"Boss, we gotta get started. We gotta—"

"Now, now, Charley", interrupts the boss, "I know it takes two years to train a salesman. I know our sales force is undermanned. I know the whole story. Lord knows you've told it to me often enough. But we're selling all the kilowatt hours we can make. And we're just getting to the point where worry about capacity doesn't keep us awake into the small hours. We're doing all right. Just keep your shirt on. There's plenty of time."

Then Charley goes back to his office and spends a few days biting his nails and accumulating pressure for another explosion. That's as it should be, it seems. The boss expects it of him, depends on him to keep the matter alive.

That's as it should be. Well, maybe. It certainly keeps the boss from forgetting about selling, even if he does continue to put off the day of decision. It gives him a comfortable feeling that when he finally makes up his mind Charley will be right there ready to go. Of course, Charley is kind of excitable—that's his salesman's enthusiasm—and rather inclined to cry "wolf" with his talk about training, and time needed to build up sales momentum, and everybody knows that sales managers never have enough salesmen.

That's as it should be. Is it? Could it be possible that the boss has been holding Charley at arm's length for so long that it has become a habit? (We discoursed on the habits of selling and of not-selling a few weeks ago, EW April 24, p 80.) Might be a good idea to look it up.) There is danger that the boss will hold Charley off too long. The danger is not one that will come sneaking up tomorrow. It has "snuck up" already. It is right here. It is time for the boss to drop the bar and let Charley go. That's as it should be.

Procrastination is the thief of time—and of net earnings. The power company that has held its Charley under the wraps until now will probably find that out. And the company that continues so to hold him will certainly make that unpleasant discovery when it is too late to do very much about it.

The Electrical Week

South Carolina Electric & Gas Co has taken its fight with Santee-Cooper to the public. It is using ads in New York and Washington papers as well as in all South Carolina dailies. The state-owned authority is sponsoring a loan to the Central Electric Power Cooperative by REA. The money would be used to build a transmission system to compete with the investor-owned utility (p 72) . . . Higher hardware cost is justified if better life and design result, EEI Transmission and Distribution Committee was told at Denver (p 74) . . . The Pacific Gas & Electric Co has been purchasing energy from the Reclamation Department's California projects on a day-to-day basis. Now it is after a long-time contract. However, Interior Secretary Chapman has his objections, and PG&E has a reply to them (p 75) . . . SEC will start hearings on June 16 which may determine the existence of American Power & Light Co. In the meantime AP&L has filed with the regulatory commission a plan for distributing the proceeds from the sale of Pacific Power & Light Co at the rate of $6.90 a share (p 78).

• • •

Major shuffling of top federal power jobs last week followed Congressional acceptance of two Truman reorganization plans. The President named Mon C. Wallgren as Federal Power Commission chairman and appointed two additional Interior assistant secretaries, Vernon D. Northrop and Dale E. Doty. He also chose Chairman Harry A. McDonald to continue as head of Securities and Exchange Commission.

Though replaced as chairman of Federal Power Commission, Nelson Lee Smith won reappointment for another five-year term as a member. At the same time, Commissioner Paul R. Rowen was appointed to the Securities and Exchange Commission for five years. Both must be confirmed by the Senate.

Delegates to the recent Public Utilities Advertising Association convention split sharply on the value of area development advertising. The trouble: Results cannot be measured.

Vacuum cleaner sales are still running ahead of last year. Totals for the first four months of each year are 1,166,343 for 1950 and 1,032,896 for 1949.

AEC was spreading its scientific brainpower too thinly in trying to build many reactors simultaneously. That's the reason that the "first practical power reactor" at Knolls Laboratory has been temporarily put on the shelf. But scientists emphasize that advances made on other reactors all will speed the development of atom power plants.

Joseph A. Erickson, president, Federal Reserve Bank of Boston, states that the average cost of producing electricity in New England is much more likely to be reduced by a continued supply of reasonably priced foreign oil than by the developing of more hydro sites.

The past decade may go down in history as the decade of plant expansion. The present decade may be the one known as the decade of office expansion. Connecticut Power & Light Co and Arkansas Power & Light Co are two of the many companies erecting new office buildings.

The 1949 Annual Report of Arkansas Power & Light Co is called *Newsyear*. It follows the format and style of the nationally circulated *Newsweek*.

Sales by electrical goods wholesalers are continuing to climb. March sales, reported by the Bureau of Census, were 90% over the same month last year and showed a seasonal gain of 18% over the preceding month. First quarter sales were 4% above the first quarter in 1949.

Notes From The News

Grand Coulee gates have been opened to make room for more water in the battle against expected floods on the Columbia River. Release of 375,000 acre-ft of water will drop the reservoir 5 ft below its present level . . . Louisville Gas & Electric Co's electric output for the week ended May 20 was a new high for the company. The week's total of 29,058,000 kwhr was 15.88% higher than the corresponding week a year ago . . . South Carolina's House of Representatives has ordered an inquiry into the entire electric power situation in the state, including the state-owned Santee-Cooper project. Santee-Cooper is encouraging a co-op to duplicate power company lines. Then it will sell power to the co-op at 6.2 mills per kwhr. A private firm has offered to sell the power at 5.5 mills per kwhr . . . Cost of electricity to TVA residential consumers hit a new low of 1¼c a kwhr in March. Annual consumption per residence jumped to 2,992 kwhr in the last year . . . A 1949 Washington State law allowing two or more public utility districts jointly to buy private power facilities faces a test before the State Supreme Court.

Ads Rallying Public Opinion for Utility

South Carolina Electric & Gas Co Uses New York, Washington, and Local Newspapers to Tell of Fight with Santee-Cooper over Rival Co-op Grid

PUBLIC OPINION appeared to be rallying for the South Carolina Electric & Gas Co a week after the utility told its side of a bitter public-private power battle in local and national advertising.

More than 150 letters and telegrams, the great majority of them applauding the company's stand, followed publication of advertisements in New York City, Washington, and South Carolina daily newspapers. In addition, the South Carolina House of Representatives voted to probe activities of the South Carolina Public Service Authority, a long-time foe of SCE&G. And locals of the International Brotherhood of Electrical Workers, AFL, announced they would organize labor support in behalf of the company's "fight for life."

Ads Hit Transmission System

The two advertisements, reproduced on these pages, were prepared by S. C. McMeekin, president of Electric & Gas. They told of an involved problem, centering around a Rural Electrification Administration loan for an extensive co-operative-owned transmission system largely in the service area of Electric & Gas. This net would carry energy from the Public Service Authority's Santee-Cooper hydroelectric project to 14 rural electric cooperatives. It would be operated and maintained—and eventually owned—by the state agency.

Stress Lend-Lease Feature

The McMeekin advertisements highlighted this "lend-lease" feature of the REA loan, a device by which the federal lending agency has financed facilities for other government power operations, particularly for the Interior Department. He charged that the approximately 800 miles of lines proposed by the Central Electric Power Cooperative, a combination of the 14 distribution co-ops, would be "an unneeded, duplicating transmission system, involving the unwarranted waste" of federal tax funds.

The advertising also evoked a defense of the $7,595,500 loan already approved by REA for the Central Electric co-op, which reportedly is seeking another $1.5 million in addition. REA Administrator Claude Wickard termed McMeekin's statements "misleading" and designed "to prejudice the public against the conduct of the REA loan program." Wickard pointed out REA has had authority to make loans for generation and transmission facilities since it was founded in 1936. The 14 distribution co-ops, he asserted, would purchase power at lower cost under the Central Electric-Public Service Authority arrangement than at the 7.5-mill rate they "have been paying" South Carolina Electric & Gas.

McMeekin said he had offered the co-ops a lower wholesale power rate—5.5 mills under a 15-year contract—but had been refused. His advertisements announced the company would serve the co-ops at the 5.5-mill rate anyhow, and that this would be 10% below the 6.2 mill rate proposed by the Public Service Authority.

However, the company's principal quarrel appeared to be with the Public Service Authority, rather than REA or the co-ops. McMeekin charged that the REA-financed transmission system would permit the Authority to expand beyond its normal function of producing power and to compete for city and industrial customers of the company.

The Public Service Authority was created to operate the Santee-Cooper project, which was built with some $65 million of federal loans and grants. Last year the authority took to the courts its

DID YOU TELL YOUR CONGRESSMAN TO KILL MY BUSINESS?

The execution will waste at least $9,000,000 of your money and destroy a sound American company worth $100,000,000.

Do you want your Congressman to kill this American system?

THIS advertisement was used in Washington and New York City papers

We Can Save the People $9,000,000!
We Will Save Electric Co-op Customers More
Than 10% on Every Kilowatt Hour They Buy!
HOW?
WHY?
WHAT SHALL WE DO!
WHAT DO YOU WANT!
WE HAVE ALREADY OFFERED:
Some of These Offers Was Accepted!
WHAT MORE CAN WE DO?
These are the facts.
What do you think?
What more can we do?
South Carolina Electric & Gas Company

ALL DAILY newspapers in South Carolina carried this advertisement

futile fight to prevent the purchase of the South Carolina Power Co by SCE&G. The state agency asserted that it hoped to purchase the latter system as an outlet for Santee-Cooper power.

The State House of Rerpresentatives' investigation of the Public Service Authority was taking shape this week with the selection of a committee to make the study. Meanwhile, on May 24 the Central Electric co-op placed a contract for the first 104 miles of the projected transmission network.

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Vepco to Enlarge Plant

Virginia Electric & Power Co has announced plans to add an 80,000-kw unit to its Chesterfield Station. The unit will be located on the James River near Drewry's Bluff. The installation, which will cost $12 million, will increase the Chesterfield Station's generating capacity to 235,000 kw.

2 Midwest Utilities Plan Major Interconnection

Union Electric Co of Missouri and Kansas City Power & Light Co plan to interconnect their systems with a 190-mile, 161-kv transmission line. Union Electric will construct a line from its Bagnell Dam north to Moberly, Mo., where KCP&L will pick it up and continue it to Kansas City. Cost is estimated at $4.5 million.

Union Electric now has a capacity of 1 million kw, and KCP&L has 800,000 kw. The interconnection will enable both systems to use their most efficient units, will create a reserve pool to draw upon during repairs and maintenance outages, and will smooth out construction programs.

Missouri Power & Light Co, Jefferson City, a wholesale customer of Union Electric, will also benefit from the interconnection.

Phone Co-op Dissolves, Hits Northwestern Bell

One of the Rural Electrification Administration's first farm telephone loans to a rural cooperative has been rescinded and the co-op dissolved—three weeks after the loan was approved.

Iowa Falls (Iowa) Rural Telephone Cooperative told the following story:

"Late last summer, the (Northwestern) Bell (Telephone) Company informed us that it would be necessary for us to rebuild our lines if we wished to continue to switch over its facilities. At that time numerous Bell officials informed us that the company was not in a position nor was it interested in extending rural service in this area.

Co-op Only Way Out

"We were given to understand that the responsibility was ours to provide our own telephone service. We proceeded to organize our cooperative which we did and to which a loan was made.

"At virtually the same time that we undertook the organization of the cooperative, Bell publicly announced a reversal of its earlier policy—a fact which it readily admits today. Bell stated that it stood ready to extend service in rural areas to anyone desiring it.

"This reversal of policy, plus—to put it very charitably—the very sympathetic hearing which all those seeking Bell service received from Bell officials seriously weakened the cooperative.

"Eventually the Bell attitude and tactics could be characterized as nothing short of 'spite line' activity such as was so prevalent on REA cooperative lines in the early days. Under that pressure, one line—the Iowa Falls-Owasa line—voted to sell to Bell.

"The loss of this line made the feasibility of our loan very questionable. We therefore met with REA officials and Northwestern Bell Officials.

Effort Not in Vain

"In view of the commitments made by the company, plus the sale of the Owasa line, we feel that it is only good judgment to dissolve the cooperative. In doing so we feel that our effort, the loyalty of the cooperative members and the assistance of REA have not been in vain. We have, we sincerely believe, the assurance of good telephone service at reasonable rates—which was our primary objective.

"It is regrettable that the effort which has been put in was necessary to accomplish this purpose. We regret, too, the misunderstandings which may have resulted between certain parties during these efforts."

NATIONWIDE viewpoint was brought to EEI Transmission and Distribution Committee meeting by men such as W. J. Piper, Detroit Edison Co; J. W. Anderson, Philadelphia Electric Co and general engineering sponsor; and H. E. Jung, Southern California Edison Co

Higher Hardware Cost Justified If Better Life and Design Result

CONSIDERABLE INCREASE in hardware unit cost can be justified if it results in longer life and a substantial improvement in design coordination of life of overhead line supporting structures. Speaking before the spring meeting of the Transmission and Distribution Committee of the Edison Electric Institute in Denver, E. W. Oesterreich, Duquesne Light Co, pointed out that hardware items control substantial changes in annual cost of the structure.

Although the cost of the hardware is only of secondary importance in total cost, life of the material items determines degree of coordination of design, number of replacements to be made and labor and dravage expenditures to be incurred. Total average annual costs can be substantially reduced by relatively small increases in hardware unit prices, he said, posing this question: "If a three-man crew and truck costs about $7.50 per hour, is it luxurious to spend 25¢ instead of 12¢ for a bolt to save at least $2.00, the very minimum for that crew to replace the 12¢-bolt gone bad too soon?"

Keen interest in the possibilities of corrosion resistant hardware was evinced by a panel discussion of utility and manufacturer representatives. R. H. Earle, Line Material, reported on studies indicating that substantially the same order of life may be developed for hardware by coating changes as is being realized with low alloy steels. Costs would be 50% or less of the increased cost of low alloy steel over milled-mild steel.

C. E. Baugh, Pacific Gas & Electric Co, detailed the difficulty of obtaining satisfactory life on the West Coast, where galvanizing is often completely gone after 12 months' exposure. One drawback in using special premium hardware, he said, is the difficulty of seeing that it is used only in locations where it is needed and economically justified.

M. M. KOCH, left, vice-president in charge of electrical operations, Public Service Co of Colorado, has a talk with J. E. McCormack, Consolidated Edison Co, chairman of EEI Transmission and Distribution group

R. M. Hayward, Public Service Electric & Gas Co, favored a material not requiring coating of any kind and recommended consideration of aluminum hardware under special conditions. He listed as advantages its lighter weight, adequate strength, and lack of need for maintenance.

Walter J. Piper, Detroit Edison Co, reported that an electropotential survey indicated that approximately half the towers on his company's system in the ground 20 to 30 years are adequately protected against corrosion of their underground structures. He said the electropotential method is so rapid that many towers can be checked in the time it takes to examine one by chemical or visual methods.

H. E. Jung, Southern California Edison Co, summarized results of a voltage complaint survey showing that in operating under the EEI-NEMA preferred voltage ratings approximately 70% of all voltage complaints were low voltage. In view of the unjustified complaints received, Jung said, it is apparent that manufacturers of appliances, lamps, and other devices have a long way to go in building into their products design voltages recommended in the preferred voltage ratings.

In describing the development of Denver's extensive mercury vapor street lighting system, which now totals 3,591 units in service, M. H. Powell, Public Service Co of Colorado, stressed the psychological value of the distinctive color of mercury vapor light. He mentioned the need for a satisfactory means of properly evaluating street lighting and of showing a customer in advance what he would be getting for a particular specification.

J. C. Livesay, Colorado Central Power Co, said his company had installed mercury vapor lighting in ten municipalities on its system and feels that such street lighting is one of its most potent public relations tools.

City Accepts Contract

A 10-year contract with the Union Electric Co of Missouri to supply electric power to Rolla has been accepted by the city council. Union Electric will begin supplying power about Jan 1 after a substation is erected just outside the city and a double transmission line is built into Rolla. The city formerly received power from the Sho-Me Power Corp. City officials believe about $27,000 a year can be saved on the contract with Union Electric.

INTERIOR'S OSCAR L. CHAPMAN

What kind of contracts can private power make with the Interior Department and its power agencies? The answer, important to companies trying to deal with the Reclamation Bureau and Bonneville, Southwestern, and Southeastern Power Administrations, apparently boils down to what terms Interior will accept.

Interior's views on the subject are cynical, to put it mildly. The following article, combining Interior testimony and that of one company before the Senate Appropriations Committee, indicates the difficulties faced by other companies hoping to make agreements with the Department.

PG&E'S ROBERT H. GERDES

Interior Objects to a Utility Contract

Testimony before Senate Appropriations Committee Indicates Difficulties Faced by Pacific Gas & Electric Co (and Other Companies) in Making Pact

LAST YEAR Congress urged the Interior Department to try to make agreements with a number of power companies. One of these, Pacific Gas & Electric Co, says it has been willing but has found Interior something less than enthusiastic.

PG&E has been purchasing the entire output of Reclamation's Central Valley of California project plants, Shasta and Keswick, on a day-to-day basis for more than a year. With negotiations for a more stable arrangement at a standstill, PG&E on Feb 17 submitted a proposed contract to the bureau.

Early in April, Chapman told Congress he was "unable to report that any substantial progress has been made (with PG&E). Instead of considering the bureau's proposal, the company has made the government a counter proposal containing conditions which cannot be accepted because they run counter to the public power policy of the government."

Retorted PG&E's general counsel, Robert H. Gerdes, "He can have a contract if he wants it."

Last week the Senate Appropriations Committee published the testimony on Interior's annual budget. The Department and PG&E testified separately but their major points of disagreement form the basis of an enlightening, if hypothetical, debate.

Seven points of objection by Interior to the company proposal were listed in testimony of Reclamation's power chief Harvey F. McPhail. The answers to these objections are those of Gerdes.

1. Interior—The contract proposal so limits our firm capacity at Shasta and Keswick that it extends the repayment period by over 30 years.

PG&E—The company proposal does not limit the firm capacities at Shasta and Keswick Plants, except in one small particular. On the other hand, the entire dependable capacity of Shasta and Keswick will be made firm when coordinated with the company's numerous hydro and steam plants. The exception: In our proposed draft, we suggested that 10% of the dependable capacity be withheld by the bureau as a reserve for its power customers. If the bureau is to set up a competitive power system, it, like any other utility, must maintain a reserve—and 10% is a low figure.

2. Interior—It limits the number of preference customers to such a small number that the bureau, in effect, cannot carry out the preference provisions of the Reclamation law.

PG&E—The contract definition of preference agencies to be served is as broad as the Reclamation law itself. While our proposal requires that federal establishments and preference customers have a demand of 500 kw or more (a relatively small amount of power), this is exactly the requirement proposed by the bureau itself in contract negotiations.

3. Interior—It would establish the Pacific Gas & Electric Co as a preference agency customer, which is contrary to federal power policies and law.

PG&E—Now, for the first time, we are informed . . . it is contrary to federal power policies and law for any government power to be reserved for sale to the company. We can find no such provision in the law. However, if the bureau believes its objection is valid, we will withdraw our request that 25% of the power be reserved for company uses. . . .

4. Interior—It would prohibit the bureau from serving any customer directly.

PG&E—The intent of the proposed contract is to provide for such service to the government and its customers without expenditure of federal funds, with service furnished for less than it would cost the government to provide over its own facilities.

5. Interior—It involves the sale of federal power in a manner by which the federal government would, in effect, be subject to the complete jurisdiction of the California Public Utilities Commission.

PG&E—The company is, of course, subject to the complete jurisdiction of the California commission. If a fair contract is arrived at, there would be no difficulty in obtaining approval by the California commission. We know of no existing law under which the California commission would obtain jurisdiction of the bureau if it entered into the proposed contract with the company.

6. Interior—It does not provide for the inclusion of future hydro projects which may be developed by the federal government.

PG&E—The bureau will not have any other by-product hydro power available until at least 1955. . . . We had no reason to assume that the bureau desired to include other sources of power in the contract.

7. Interior—It does not provide for firming steam capacity.

PG&E—Deficiencies in bureau power output would normally be supplied from the company's steam plants. . . . It is utterly incorrect to say that the company has refused to furnish steam firming capacity.

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Iowa Co-op Asks Court to Clear Way for Project

First Iowa Hydro-Electric Cooperative is asking the Supreme Court to clear the way for its decade-old proposal to construct the Moscow Dam project on the Cedar River in Iowa.

The project received an FPC license and the Supreme Court approved the license five years ago. Meanwhile, the State of Iowa has fought the project by continuing court action. Present litigation centers on FPC hearings held in 1946 to amend the original plan.

Present move by First Iowa asks the court to deny further review of the case, which is sought by the state.

Earlier this year, First Iowa abandoned efforts to get a Rural Electrification Administration loan and announced plans for private financing (EW, April 3, P 13). These plans cannot be carried out while the court action is pending, and the FPC license requires start of construction by September.

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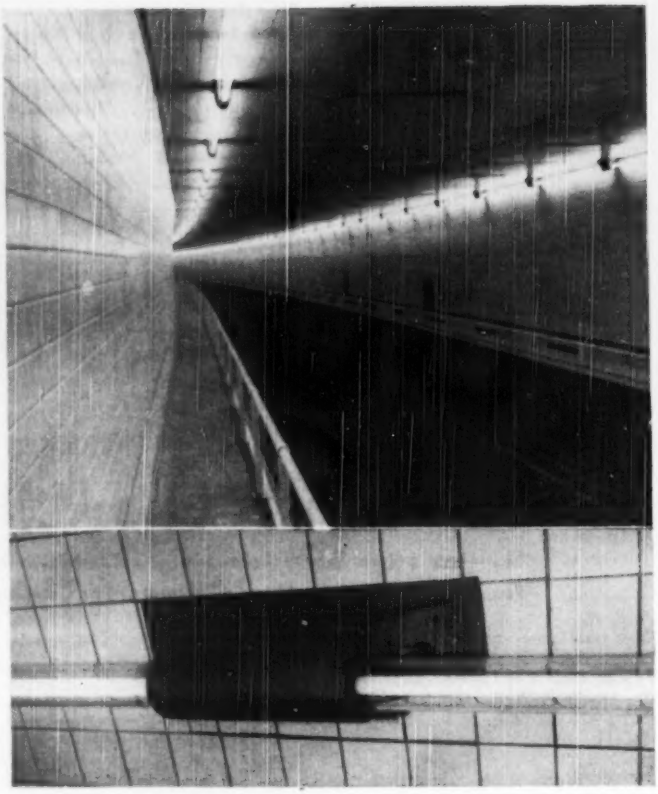
Niagara Mohawk Asks OK on U.S.-Canada Pact

Niagara Mohawk Power Corp has recommended prompt Senate ratification of the treaty recently negotiated by the United States and Canada to divert additional water from the Niagara River. The recommendation was in a letter from Earle J. Machold, president of the utility, to Tom Connally, chairman of the Senate Committee on Foreign Relations.

The company's subsidiary, Niagara Falls Power Co, now operates the only hydroelectric plants on the river. If the treaty is approved, Niagara Mohawk will ask the Federal Power Commission for a license to enlarge these plants or to build others.



TWO LINES of light illuminate each vehicular tube of New York City's new Brooklyn-Battery Tunnel. At bottom is closeup of the Pyrex tube which houses the fluorescent lamps. Cast bronze ceiling boxes carry lighting transformers serving the two lamps adjoining

Fluorescent Lighting Used in Brooklyn Tunnel

Illumination is a "line" of light in the Brooklyn-Battery Tunnel, which was opened to traffic on May 25. The two-tube tunnel is 9,117 ft long from portal to portal, reportedly the longest and deepest in the United States.

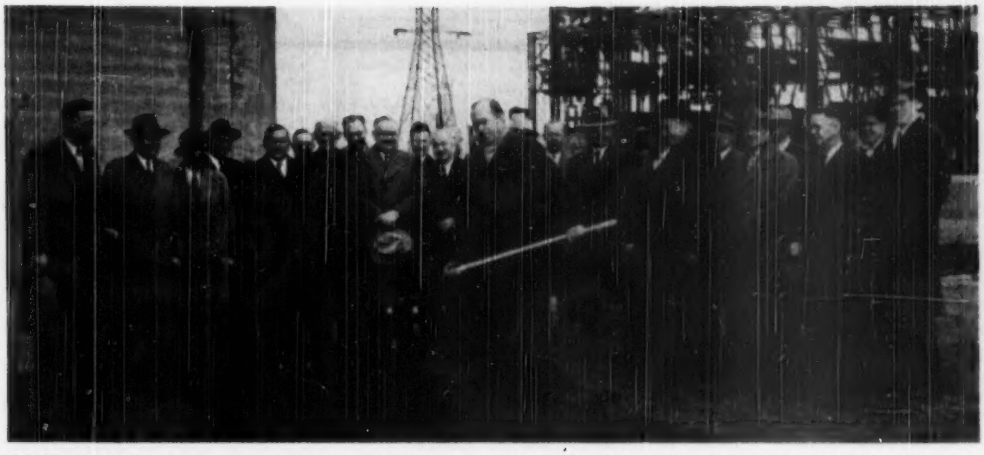
Both vehicular tubes have two continuous lines of fluorescent lamps, each line located on the 13-ft 6-in. ceiling close to each sidewall. The lines consist of 6-ft slimline 4,500 deg fluorescent units inside 2.5-in. Pyrex tubes and set end to end. The circuits are staggered to insure continuity of light regardless of individual phase failure. The line of light arrangement gives uniform and steady illumination on the sidewall and eliminates the intermittent flashing effect formerly experienced with incandescent lamps by drivers following other cars.

Cold cathode operation gives a light intensity of 4 ft-c on the roadway for the greater part of its length. For a distance of 1,825 ft from the entrance to each tunnel, hot cathode operation with current regulation is used to control intensity according to outside light conditions. The lamps are controlled from the service building at the Brooklyn portal.

•

Converting to 60 Cycles

The British Columbia Power Commission is converting its Comox Valley area of Vancouver Island from 25 to 60-cycle energy. Residential and commercial customers will have to pay for the conversion of their electrical appliances. The commission will lend each customer up to $150 at 6% interest. The loan plus interest must be repaid in 12 months. The commission claims that if it were to pay for converting appliances of individual users the cost would have to be reflected in rates to all consumers even though some had no appliances to convert.



GROVER C. NEFF, president of Wisconsin Power & Light Co, turns the first shovel of earth to start work on the addition to the Edgewater Plant, Sheboygan, as officials of the company and guests look on. New 60,000-kw unit will double station's capacity

Telemetering Discussed at AIEE-NTF Meeting

Exchange of concepts and comparison of requirements of telemetering of so-called mobile and point-to-point systems were achieved at a Joint Conference in Philadelphia, May 24-26. Manufacturers, utility meter experts, and avigation specialists met under auspices of the American Institute of Electrical Engineers and the National Telemetering Forum. Evolutions of the two fields were outlined at the start by Perry Borden, Bristol Co, for AIEE and W. J. Mayo-Wells, Johns Hopkins University, for NTF.

Papers and discussion throughout accentuated the difference in expected apparatus life, necessity for multiplexing, and the speed of response. Much of the mobile or guided missile telemetering is done with pulsed high-frequency, and many more items of flight information are required in brief time than are commonly demanded of power system telemetering.

A new high speed telemetering system using frequency as a translating means and with automatic calibration at frequent intervals to compensate for changes in vacuum tubes and other circuit elements was described by W. E. Phillips, Leeds & Northrup. Maneuvering of generator loading is facilitated. Frequencies of 20 to 25 and 80 to 100 cps can be used simultaneously.

Impulse duration schemes are used extensively in the natural gas industry said W. E. Ruffeth, Bristol Co. now that the aversion to electrical telemetering has largely vanished. In discussion K. M. Uglow of the Naval Research Laboratory mentioned a new method of "inside out" wave-guide propagation using a special dielectric coating on the outside of the pipes.

Crystal diodes were dominant nonlinear rectification elements of a 2-conductor system without vibrators or galvanometers described by F. F. Uehling, consulting engineer.

Versatility of an adjustable-core transformer scheme of telemetering of plant and industrial process measurands (quantities to be measured) was demonstrated graphically by A. J. Hornfeck, Bailey Meter Co. Addition, subtraction, ratio, squares, square roots, and totals are readily obtainable.

Magnetic tape recording offers the opportunity to store large quantities of telemetered information in small space, said M. J. Stolaroff, Amplex Electric Corp.

About 200 registered for the sessions and saw the exhibits displayed by Nicad, Leeds & Northrup, Bristol, Metrotype, Gould, General Electric, the Navy, and the laboratories associated with Princeton and Johns Hopkins Universities.

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To Install 150,000-Kw Unit

Indiana & Michigan Electric Co, subsidiary of American Gas & Electric Co, has authorized the construction of a second 150,000-kw unit at the Tanners Creek steam-electric generating plant, located on the Ohio River at Lawrenceburg. The first 150,000-kw unit is scheduled for completion in February 1951. The second unit is expected to be completed in October 1952.

Utility's Pipeline Request Is Dismissed by FPC

Jersey Central Power & Light Co's application for permission to build a seven-mile pipe line in New Jersey has been dismissed by the Federal Power Commission for lack of jurisdiction.

The proposed line would extend from a point on Jersey Central's existing system near Old Bridge to the utility's electric power plant in Sayreville. The natural gas transported through the line would be used solely in the electric generating plant.

FPC ruled that the existing system can only be used for purposes originally authorized and gas for the electric plant may not be transported unless the commission amends the certificate first granted on petition of Jersey Central.

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Anti-Utility Strike Law in Wisconsin Is Upheld

The Wisconsin State anti-utility strike law has been upheld by the State Supreme Court in a case involving the Milwaukee Electric Railway & Transport Co and the AFL Street Car Men's Union.

In upholding the law and a strike injunction issued under it, the state court found that the law was not unconstitutional because it did not abridge the right of free speech, did not permit involuntary servitude, did not deny equal protection of the laws, did not take property without due process of law, and did not deprive the liberty to contract as claimed by the union.

YIELDS (%) — Operating Electric Utility Securities

Quality	Bonds			Preferred Stocks			Common Stock		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
DATE									
1950									
May 25	2.62	2.63	2.74	3.77	4.00	4.32	5.01	5.96	6.89
May 18	2.62	2.65	2.74	3.77	3.99	4.32	5.06	5.97	6.63
END OF QTR.									
1st 1950	2.59	2.61	2.71	3.78	4.01	4.36	5.22	5.85	6.67
4th 1949	2.59	2.61	2.72	3.85	4.06	4.46	5.37	6.15	7.01
3rd 1949	2.61	2.65	2.77	3.88	4.15	4.54	5.55	6.67	7.51
2nd 1949	2.69	2.75	2.88	3.98	4.26	4.66	5.94	6.96	8.14

Dolan, Berg & Chandler, Inc.

AP&L Would Distribute Proceeds of PP&L Sale, Answers Petitions

THE QUESTION of how long American Power & Light Co will continue to exist may come before Securities and Exchange Commission June 16.

SEC has scheduled a hearing for that date on a plan American filed May 24 for distribution to its stockholders of cash realized from the sale of Pacific Power & Light Co. The Commission may incorporate in the same proceeding three petitions asking speedy dissolution of the holding company. American wants the petitions considered only "as statements of position of petitioners."

The distribution plan calls for a cash capital distribution of $16,139,211.79 (or $6.89 a share), slightly more than the proceeds of the Pacific P&L sale.

Distribution would be made in about two months, American said—after SEC approval of the application and the issuance of a court order under Section 11 (d) of the Public Utility Holding Company Act. American said it prepared the distribution after the Commissioner of Internal Revenue ruled that amounts received by stockholders would reduce their tax cost of stock of American and only excess, if any, of cash so received over tax cost would be taxable as capital gain.

American also filed with SEC May 29 a formal reply to petitions by H. Lane Ogle, owner of 1,700 shares of American's common stock, and a group headed by the firms of Goldman, Sachs & Co of New York and Gerstley, Sunstein & Co of Philadelphia. These groups had asked dissolution of the holding company and distribution of its remaining securities and cash assets among the common stockholders. American included an answer to the Washington Public Service Commission's petition for removal of American's holding company status over Washington Water Power Co.

In its reply American said it was taking steps in cooperation with WWP management "to effect a substantial improvement in the operating results and in the earnings accruing to the interest of American's stockholders. . . . Until this program has been afforded a reasonable time to show results, any compulsory divestment of the Washington Water Power Co would probably be vigorously resisted by stockholders who have more than a short-term speculative interest in American."

Specifically attacked as representing a short-term interest was the Gerstley, Sunstein & Co group.

To the stockholder groups American pointed out that since the commission's dissolution order was entered in 1942 market value of American's preferred stock has increased 700% and common stock 3,000%. "Certainly," the answer said, "no stockholder can properly make the above accomplishments the basis of complaint."

Use of Section 11 (d) in this case would be "without justification and without precedent," according to the holding company. Ogle's dissolution proposal was filed under this section, which gives "any person having a bona fide interest" in a holding company the right to offer a reorganization plan. This section has been invoked but once, American pointed out, and there the company involved requested it.

American attacked the Washington PSC's analysis of disadvantages of holding company ownership of WWP as "mere conclusions" with no basis. Remote ownership would not be changed by distribution of the stock to American stockholders, the company argued.

American, said the answer, "has been and is contributing to efficient management and operation (of WWP); and American is clearly in a better position to do so than the thousands of scattered stockholders to whom the Washington commission wants the stock to be distributed."

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Delay in Southern Utah Sale Ordered by SEC

Sale of Southern Utah Power Co, Cedar City, to the city of Cedar City and a Utah generation and transmission cooperative, Southwest Utah Power Federation, has been delayed by Securities and Exchange Commission because "there has not been an adequate showing of maintenance of competitive conditions" in negotiations for the common stock.

SEC gave Washington Gas & Electric Co ten days in which to amend its proposal for sale of its Southern Utah stock to provide equal opportunity for all interested persons to bid for the securities. The sale had been negotiated for a base price of $550,000 for the 62,910 outstanding shares of no-par common stock of Southern Utah plus adjustments. The commission told Washington G&E's trustee in reorganization to submit an amendment providing for sale of the stock at a price to be set by "arm's length" negotiations.

Electric Utility Financing—May 20-27

Company	Description	Amount of Offering (000)	Offering Price	Yield at Price to Public
Bonds				
Interstate Power	3% 1980 ref	$3,000	102.50%	2.875%
Preferred				
Interstate Power	100,000 sh 4.70% $50 par ref and new money	5,150	$ 51.50	4.56
Iowa Public Service	50,000 sh 4.20% $100 par new money	5,122	102.439	4.10
Common				
Interstate Power	275,000 sh new money	2,544	9.25	
California Electric Power	180,000 sh new money	1,553	8.625	
Wisconsin Power & Light	320,231 sh new money	5,364	16.75	

SCHEDULED

Bonds: Wisconsin Power & Light, new money, $8 million.

Common Stock: Northern Indiana Public Service, 422,000 shares, new money, $8.5 million.

February Energy Sales Up 5.4% from Last Year

Sales of electric energy in February were well above those for the same period of 1949.

Total sales to ultimate customers amounted to 22,203,216,000 kwhr, which was 5.4% above the 21,070,943,000 kwhr sold in February, 1949.

Kilowatt Hour Sales February	Million Kwhr 1950	Million Kwhr 1949	Percent Change
Residential or domestic	6,017	5,249	+14.2
Rural (Distinct rural rates)	405	456	−11.1
Commercial or industrial			
Small light & power	4,076	3,800	+ 7.3
Large light & power	10,397	10,183	+ 1.1
Street and highway lighting	251	233	+ 7.4
Other public authorities	597	550	+ 8.5
Railways and railroads			
Street and interurban	304	321	− 5.2
Electrified steam railroads	203	211	− 3.7
Interdepartmental	52	48	+ 9.5
Total to ultimate customers	22,203	21,071	+ 5.4

Revenues from ultimate customers rose 6.8%, from $389,489,400 in February last year to $416,129,500 this year.

Average revenue per kilowatt hour, however, declined 2% in terms of a 12-month period. It was $2.93 in the year ended Feb 28, compared to $2.99 for the corresponding period a year ago. The average customer's use for the 12 months was 1,713 kwhr, or 8% above the previous year's 1,586 kwhr, and the average annual bill rose 5.8%, from $47.42 to $50.19.

MEETINGS

Edison Electric Institute
Annual Convention, Auditorium, Atlantic City, N. J., June 5-7.

American Institute of Electrical Engineers
Summer General Meeting, Huntington Hotel, Pasadena, Calif., June 12-16.

National Association of Electrical Distributors
Annual Convention, Convention Hall, Atlantic City, N. J., June 12-16.

Pennsylvania Electric Association
Relay Committee, Castleton Hotel, New Castle, Pa., June 15-16; Electrical Equipment Committee, Abraham Lincoln Hotel, Reading, Pa., June 19-20.

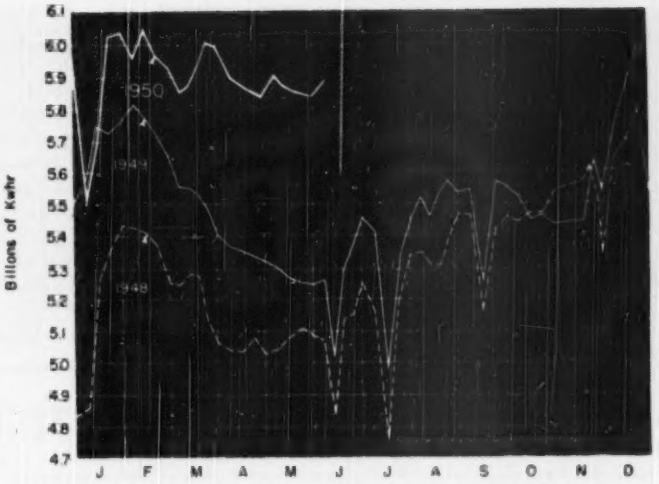
Canadian Electrical Association
Annual Convention, Manoir Richelieu, Murray Bay, Que., Canada, June 15-19.

American Society of Mechanical Engineers
Semi-annual Meeting, Hotel Statler, St. Louis, Mo., June 19-23.

American Society for Testing Materials
Annual Meeting with Exhibit of Testing Apparatus and Related Equipment, Chalfonte-Haddon Hall, Atlantic City, N. J., June 26-30.

CIGRE
International Conference on Large Electric Systems, Paris, France, June 29-July 8. I. W. Gross, secretary, American Gas & Electric Service Corp., 30 Church St., New York 8, N. Y.

World Power Conference
London, England, July 10-12. H. C. Forbes, secretary, Consolidated Edison Co., 4 Irving Place, New York 3, N. Y.



Output Week Ended May 27—5,893,782,000 Kwhr

Weekly Output, Millions Kwhr

1950	1949	1948
May 27 5,894	May 28 5,270	May 29 5,076
May 20 5,845	May 21 5,255	May 22 5,085
May 13 5,864	May 14 5,257	May 15 5,109
May 6 5,872	May 7 5,284	May 8 5,087
Apr 29 5,902	Apr 30 5,304	May 1 5,042
Apr 22 5,846	Apr 23 5,326	Apr 24 5,027
Apr 15 5,863	Apr 16 5,343	Apr 17 5,087
Apr 8 5,898	Apr 9 5,367	Apr 10 5,633
Apr 1 5,992	Apr 2 5,378	Apr 3 5,037
Mar 25 5,993	Mar 26 5,404	Mar 27 5,065
Mar 18 6,015	Mar 19 5,496	Mar 20 5,145

Percent Change from Previous Year

	May 27	May 20	May 13
New England	+15.0	+15.0	+13.9
Mid-Atlantic	+ 9.7	+10.1	+ 9.1
Central Industrial	+13.6	+11.0	+12.8
West Central	+10.2	+ 8.6	+ 9.5
Southeast	+12.3	+11.7	+13.0
South Central	+10.6	+11.5	+16.0
Rocky Mountain	+13.3	+11.4	+11.3
Pacific Coast	+10.9	+12.3	+ 9.4
Total United States	+11.8	+11.2	+11.6

Canadian Output Sets Record for February

Production of 3,771,093,000 kwhr by Canadian central stations in February set a record for that month. It was the twelfth successive month that total production and consumption of primary power exceeded that of the same month a year previous.

The following statistics, supplied by the Dominion Bureau of Statistics, are in thousands of kilowatt hours:

Period	1950	1949
Two Months' Output	7,842,638	7,099,197
Primary	7,421,470	6,736,949
Secondary	421,168	362,248
Primary Consumption	7,199,648	6,519,096
Net Exports to U. S.	279,405	300,421
February Output	3,771,093	3,399,725
Primary	3,544,061	3,211,287
Secondary	227,032	188,438
Primary Consumption	3,475,263	3,112,488
Net Exports to U. S.	151,459	151,235
January Output	4,072,153	3,699,472
Primary	3,878,017	3,525,662
Secondary	194,136	173,810
Primary Consumption	3,774,388	3,746,898
Net Exports to U. S.	127,946	149,186

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French Station Started

The French have begun building the largest thermal power station in Europe at Carling'in Lorraine. The station will consist of four 100,000-kw generating units. Work has already started on two of them. The first is slated to be completed by the end of this year, and the second by early next year. Carling was chosen for the site of the power station because it is located in the center of the Lorraine coal fields.

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New Type of Transmitter Developed at Stanford

Stanford Research Institute, California, has announced a new type of transmitter which will aid in opening additional air lanes for television.

The transmitter is capable of sending signals in the ultra-high frequency region of 475 to 890 megacycles. Operating on 530 megacycles, the transmitter radiates a standard amplitude-modulated picture signal of good quality. The transmitter radiates only 150 w of power, but is capable of being amplified to powers in the tens of kilowatts using relatively simple radio frequency amplifiers.

The new transmitter was developed under the direction of John H. Poole, Long Beach, Calif. It is adapted to the needs of his experimental ultra high frequency station.

WASHINGTON COMMENT

RONALD D. ROSS

CONGRESS is likely to continue its labors through the heat of Washington's summer, perhaps until Labor Day —This despite the election-year hopes for early adjournment still held by many Congressmen. But it's not too early to begin chalking up the final score on federal power legislation compiled by this second session of the 81st Congress. The pattern of what will be done—or more important, what will not be done—by Congress this year has become clear.

It was freely predicted in January that this year's Congressional activity would be pretty barren. Unlike many forecasts from the capital, that one has proved accurate. Even on relatively essential matters, the tendency has been to "duck" basic issues and avoid policy decisions. In power legislation, this approach has been encouraged by the administration. President Truman has asked that no major federal conservation measures be enacted until his Water Resources Policy Commission has reported in December. Congressional issue dodging, however, has been carried even farther.

An example was the Omnibus River and Harbors and Flood Control Authorization Bill. A sharp message from the President criticizing the measure followed his approval of it. Administration objections to the bill appeared to center around its failure to provide more projects for more aggressive federal power agencies.

On the other hand, the measure produced no real victory for opponents of federal power. It was an indecisive sort of compromise that emerged, with little satisfaction for either side. For example, the surveys authorized for New England neither committed the government to, nor barred it from, a program of federal development in that area.

Appropriations for power agencies shape up in much the same way—the agencies receiving considerable funds, but not for some of their pet projects. The Corps of Engineers and Reclamation will get less than last year's record-breaking sums, partly because last year's appropriations haven't been spent completely. Some of Reclamation's perennial projects, like the Delta steam plant, will fail again. The Interior power administrations—Southwestern, Bonneville, and Southeastern—all get increases, as will TVA. The regulatory bodies, FPC, and SEC, get small "cost-of-living" boosts. REA appropriations continue at a high figure, and there will be no new curbs on how the money REA lends may be spent.

No Congressional action is coming this year on such issues as St. Lawrence, Niagara, and several other major power projects. On the other hand, hearings on St. Lawrence revealed growing support for the seaway from steel interests and other influential groups. There is a feeling in Washington that the real issue is when the seaway will be authorized and how, not whether or not it will be.

Reorganization plans approved last month for FPC, SEC, and Interior centralize authority in the heads of those agencies and strengthen the influence of the President. Only time will tell how significant these changes really are, however.

The over-all record of Congress is one of delay on major power policy. Ballots this fall and in 1952 probably will decide not only who will tackle the still unsolved problems but also to a great extent what the answers will be.

TECHNICAL NOTES

ARCHER E. KNOWLTON

Supersonic wind tunnels take terrific powering, the latest has three 29,000-hp slip-ring motors in tandem on a 90-ft fan shaft.

Banking is moving into acceptance slowly but the movement speeds up wherever flicker becomes a nuisance.

Series lighting used to out-number multiple 9 to 1 but it may come nearer to 3 to 1 before long.

Scrapers can reclaim 70 to 90 tons of coal per hour and store more than 100 tons.

Oscillographs, with appropriate transducers and accessories, can plot light distribution, study commutator noise, study vibration, time the heddle settings for the loom shuttle, etc.

Average outage hours per year for generators in 1947 were 1,343 with field windings accounting for 361, armature windings 342, vibration 202 and armature core 146. Annual inspection averages only 198 hr.

Carrier use increase may necessitate more selective receivers. The analog computers may help solve the otherwise unpredictable attenuations encountered.

Fuse-relay coordination has given such generally good results that earlier limitations of both reclosers and fuses have largely been resolved.

Demineralization offers the opportunity to supplant evaporation and distillation as a means for deriving purified water.

Coal treated with oil to prevent dust-blow might conceivably be more conducive to pile fires because of the oxygen-absorbing propensities of many oils.

PHILIP SPORN PLANT has one unit operating, one nearly ready and two more under construction. The 600,000-kw capability may soon stretch to 900,000 kw with two further units. Original concept was of a generating center turning out 6-6½ billion kwhr yearly

The Basic Concept Behind Philip Sporn Station

Economy in large-scale generation prime objective. Outstanding features embrace: 2,000 psi, 1,050/1,000 F reheat, single 165,000-kw boiler, severe architectural simplicity, functionally divided control concentrations

PHILIP SPORN, PRESIDENT, AMERICAN GAS & ELECTRIC SERVICE CORP

FUNDAMENTAL CONCEPT behind the Philip Sporn plant design was to set new standards of economy—both capital and operating—in large-scale steam electric generation of electric energy. Everything about the project has been bent to that end: Its location, its design, the construction organization, the operating organization, and the operation of the plant itself.

Four Units at Present . . . At the time of writing (May 1, 1950) Unit 1 is in full commercial operation, Unit 2 is just about ready to go into commercial operation, Units 3 and 4 are in the steel erection stage, with Unit 3 scheduled to go on the line on July 1, 1951, and Unit 4 to go on the line on May 1, 1952.

Each of these units, originally rated at 137,500-kw capability, has since the projection of the original design, and as a result of actual operation of the similarly designed Twin Branch Unit 5 and of Sporn Unit 1, been re-rated to 150,000-kw feeder capability. The design of the plant has been developed to permit economical and ready expansion by two additional units—Units 5 and 6—and system growth has been at a rate that reasonably early construction of Units 5 and 6 can be looked forward to.

Thus the prospect of realization of the original concept of a large-scale generating center where 6 to 6½ billion kwhr of energy will be generated annually is sufficiently close to realization to make a discussion and appraisal of the detail design ideas developed for implementing the basic concept both desirable and of interest. This article will deal with their relation to and effect on the basic concept, leaving the group of articles following to cover details of design features.

Location and Extent of Development . . . The Philip Sporn Plant is located on the Ohio River at the

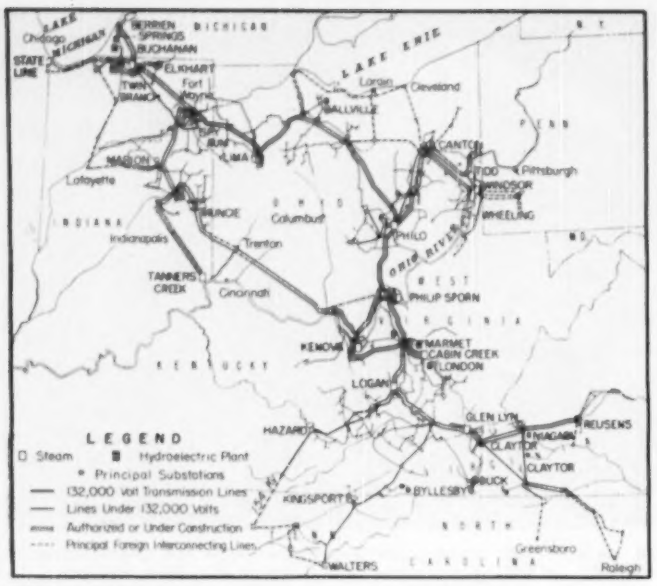


FIG 1—MIDWAY between two largest components and developed as a joint station, Philip Sporn station is also strategically centered near entire American Gas & Electric system

boundary of the two largest operating groups (Fig 1) in the American Gas and Electric Co System—The Ohio Power Co and Appalachian Electric Power Co. Thus, the station logically and very economically could be developed and has been developed as a joint station of these two companies.

Even though the ownership of the station is divided between two companies, it is pertinent to inquire if it is reasonable to plan a 900,000-kw station and to concentrate so much capacity centrally at one point. This subject was given a great deal of consideration and study, and the conclusion reached was that a rational answer to such a question could not be given except on the basis of a history of system growth—past, and expected in the future. Shown in Fig 2 is the history of the system annual peak demand, plotted logarithmically from 1928 to 1950, with a projection of expected growth in demand through 1953. For comparison, and as an aid in study of that load curve, there are shown 6% and 6.5% trend lines, based on the interval 1928-1953. Thus, on the basis of an expected peak of approximately 2,500,000 kw in 1953 (with an actual recorded demand of over 2,100,000 kw as of March 31, 1950) the plant, as constituted in 1953 with a rating of 600,000 kw, will have a capability equal to 24% of the then peak. Assuming that the plant will have reached its ultimate size of 900,000 kw in 1958, its capability will represent slightly over 25% of the then peak. On the other hand this will be but 18% of the peak expected in 1965, on the basis of a long-term 6% trend line in growth. In view of the economic advantages to be gained from exploiting the site to 900,000 kw, the development of a plant of this size was considered feasible and, in fact, highly desirable.

Advantages Shared . . . From an operating standpoint it is significant, however, to point out that each of the two operating companies party to the joint operation will have a plant at that location of only 450,000 kw. Note, however, that the joint operating arrangement gives each of the two companies the capital benefits of a high-grade site, the much lower cost of site per kw of capacity, and the very substantial savings resulting from the development of general facilities—such as coal unloading and ash handling facilities, coal storage facilities, trackage, hydraulic system, machine shop facilities, and all other general facilities forming a necessary part of a large modern plant—for a plant that is twice as big as the production facilities owned in it by each company. It also enables each company to get the benefits, operating-wise, of lower fuel costs, lower supply costs, and lower costs of supervision, operation and maintenance.

Fuel Supply . . . At its ultimate capacity of 900,000 kw, the Sporn Plant will burn close to 200,000 tons of coal a month. No projection of a plant of this magnitude, let alone actual construction, could have been made or initiated on a sound basis unless reasonable assurance as to adequacy and economy of coal supply needed by the plant had been obtained first. This assurance was provided by an extensive coal reserve continuous and contiguous to the plant, with the plant roughly in the center of the area; the reserve encompasses some 22,348 acres and an estimated approximately 90,000,000 tons of recoverable coal. An initial development of an underground mining installation will provide a capacity of 600,000 tons of washed coal per year subject to no freight costs. Remainder of the requirements for the first four units is being obtained from local commercial mines at short river transport distance from the plant. This coal will be delivered by barge to a coal dock equipped with ample facilities for unloading coal economically at the rate of 1,000,000 tons per year, or for loading coal from the extensive storage provided at the plant for delivery to other plants of the two companies located on the Ohio River or on waters tributary to the Ohio River system. Thus by intimate coordination of the two problems of site selection and coal supply an assurance of adequacy and economy of supply running the full length of the probable economic life of the present plant has been assured.

The Heat Cycle . . . Once the cycle has been chosen and the design developed on that cycle, there is substantially nothing which the operators of the plant can do to improve the thermal performance of the plant. This commitment is final as long as the plant is operated on the basis of the original design—it can only be

changed if the plant is entirely rebuilt, or if a major modernization or improvement program is carried out. In many respects the economic soundness of the plant to continue as a manufacturing center for the production of economical energy is influenced by the choice of the cycle. Yet the sound judgment necessary for determining a cycle can very seldom be given if consideration of heat balance is given independently and out of context with consideration of the other elements in a power plant, and if there is removed from the analysis of this problem consideration of what has gone before and what might be in prospect.

Progressive Economy . . . As to the first, in the case of the Sporn Plant heat balance, this viewpoint was dominant: That the essential operation in a steam electric plant is a conversion of thermal energy to electric energy, and that all other equipment, and all other functions, in the power plant are subsidiary to that main operation. Hence when it came to relative closeness of scrutiny as between justification of capital expenditures for improved thermal performance and expenditures for any other operation, it was far more desirable to doubly scrutinize non-productive expenditures such as those involving factors of space, factors of safety, and factors of decoration than the very essential expenditures which might contribute to plant efficiency —provided these latter are fully self-supporting. And as to historical background, it was most helpful to have integrated within the organization's thinking the realization that progress in economical steam generation has only been brought about by a willingness to explore and exploit relatively small individual gains, each of which, however, pushed efficiency to levels beyond any that were obtainable previously, and that no progress in the future would result if the steps that were immediately available for exploiting in the present were not fully taken advantage of.

Progress and performance in nine steam electric power generation developments on the American Gas & Electric Co System are presented in Fig 3. Each of these was distinctive and unique, and each of these represented a contribution toward economical generation of steam electric energy in its own particular sphere as against previously established standards or limits. The cycle at the Sporn Plant—2,000 psi, 1,050 F and 1,000 F reheat—takes its proper place as the culmination of a long line of forward-marching strides in thermal economy: It represents the highest practical thermal efficiency obtainable today by the use of the regenerative reheat steam cycle.

Turbine Boiler Units . . . Analysis indicated that a unit of 125,000 kw or 160,000 kw gross would give equally good results from a system supply standpoint. The subsequent studies that were made of turbogenerator units within the limits of temperatures and pressures contemplated resulted in a conclusion that the most economical results, both from a capital cost and an operating standpoint, would be given by a unit having a

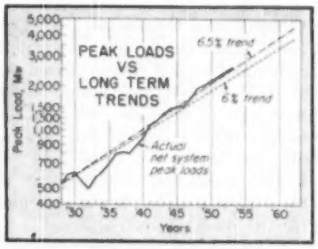


FIG 2—LOAD GROWTH indicates ample support for the system capacity increment (18% of 1965 peak) afforded by plant

nominal rating of 125,000 kw and a maximum gross capability of 160,000 kw, thus giving a feeder capability rating of 150,000 kw.

The design adopted calls for a single pulverized-fuel boiler supplying the 150,000-kw (feeder capability) alternator. The boiler was designed for full forced pressure operation without resorting to any induced draft fan. However, induced draft equipment was installed initially for ease in working out the details of the new step. No header connections are provided on the steam end. Probability methods for determining plant reliability have often failed to take into consideration system size and growth in system size, the functioning of major interconnections, and arrangements for emergency supply, and the effect of various schemes of generation, not only on capital costs but on operating costs. In the final analysis, what one is concerned with is the obtaining of the greatest reliability per dollar of investment and the lowest over-all cost of service, and this, it was concluded, was given by the basic scheme chosen.

Space Economy Preserved . . . A cross-compound turbine was chosen in order to take maximum advantage of the high internal efficiencies possible by going to 3,600 rpm on the 2,000 psi, 1,050 F high end and to 1,800 rpm on the 1,000 F reheat low end. These, however, introduced very little additional cost beyond the item of additional space required because of the treatment of the high and low pressure units as a single unit, both on the steam and on the electrical end. In operation, of course, they function exactly that way.

Even with the cross-compound idea to contend with, the design yielded a unit figure of 23.3 cu ft of building space per kw of gross capability on a 4-unit basis, and an expected figure of 22.9 cu ft when the plant is fully developed.

On the boiler end no insurmountable problems of size seemed to present themselves, in view of the experience with a unit of 120,000 kw gross generation that had been projected and that was subsequently brought on the line very successfully in 1943 at the Tidd Station, particularly so since the difference in efficiency between Tidd and Sporn made the actual ratio in heat release not 1.33, as would be expected by the difference in capability, but only 1.11.

Gains with Hydrogen Cooling . . . The turbo-alternators are hydrogen-cooled. This is standard practice today. But it is significant that neither the size of the unit nor the efficiency which that size and hydrogen cooling makes possible would be available today if it had not been for the work in development and exploitation of hydrogen cooling initiated on the American Gas & Electric System in 1928 and subsequently carried through on a long series of hydrogen-cooled synchronous condensers. Even though each of these offered economic attractions fully supporting the development, it was

recognized very early that the major gains to be obtained from hydrogen cooling would come about from its application to turbo-alternators; the experience obtained in the 22 years that have elapsed since then has fully borne this out.

On the boiler end a dry bottom was chosen because it was economically attainable for the full range of coal characteristics that the designers of the plant felt a need to provide for to give an economical supply of fuel; because that eliminated some of the difficult—to say the least—problems always associated with the handling of large-scale molten slag hearths or floors; and in no small measure because the difficult problems introduced by uncertainty as to rate of heat transfer that are always present in a wet bottom operation are automatically eliminated, or substantially so, when the ash is handled on a dry basis.

Electrical System . . . No distribution will be carried out at generating voltage. It will all be at a single voltage of 138 kv for the first three units, and a voltage of the order of 300 kv for subsequent units. This made possible simplified connections between generators and transformers without the intervention of low voltage switching. Adoption of 3-phase transformers for the step-up service, utilizing three transformers per machine, one for the high voltage machine and two for each of the two windings of the larger low voltage machines, eliminated low voltage buses.

The auxiliary supply, except for emergency tie connections, was developed strictly on the unit basis, utilizing a 2,300-v bus and 2,300-v service for motors from about 150 hp and upward, and 550-v service for motors from approximately 125 hp and below.

Based upon a long and extensive experience on protection gained by the use of differential relaying, all generators, principal transformers, and all main buses have been fully covered by differential protection, the emphasis here being on providing the maximum safety with minimum expense. Thus it was felt that important as this station is, the use of full protection on equipment and buses made possible the adoption of a single switching scheme on all high voltage feeders, with a net saving in all-around cost and an improvement in the degree of reliability.

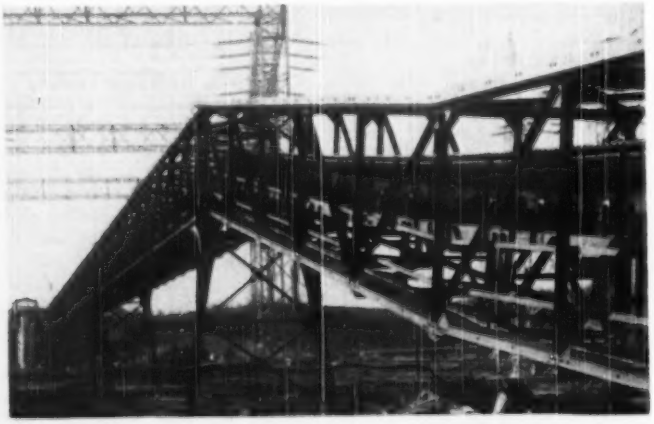
Control and Operation . . . Previous experience with a completely centralized control system carried out at Tidd Station had indicated the soundness of the basic idea, and the further development of that idea on Missouri Avenue No. 7 and Tidd No. 2 gave additional reinforcement to an original concept. It was therefore carried out to the full at Sporn.

There was also available here experience that hadn't been fully integrated in earlier designs: For example, it has been demonstrated that the operation of a plant from a centralized control point made possible not only the utilization of a much higher grade of personnel, which could be given greater scope and responsibility, but that the existence of such personnel gave the plant an additional assurance of safety and continuity of operation, not subject to hazards that are encountered in industrial relationships, even where these are carried out on the highest level of mutual cooperation. Existence and utilization of new devices, such as the electrically transmitted boiler gage glass image, furnace flame image, and the improvements in remotely operated soot blowers, all contributed to the further development of a basically sound and relatively new idea.

The control of the electrical end was again developed as part of the basic concept. First the control of turbines was made part of the centralized plant control. The plant thus assumes the responsibility for, and discharges its responsibility with, placing the unit on the high voltage buses. The problem of distribution of the plant energy then is placed into system hands and control and operation of high voltage feeders is not only placed within the high voltage yard and at some distance from the plant, but is actually made automatic. Thus economy of operation and lesser probability of disturbance of continuity are both promoted at the same time.

Personnel . . . All the key personnel and substantially all the top supervisory personnel came from other points on the system. The selections made were determined primarily by considerations of knowledge and skill required in a plant of this kind, by the desire to promote and advance every talent and ability that had shown itself capable of being advanced wherever it had shown up on the system, and by a determination to accept the temporary weakening of organization at existing plants that would inevitably result from a loss of capable men to the new plant.

Here it was felt that such weakening would not only be temporary but that, in compensation, opportunities would be presented for developing and promoting still younger men to be brought into the postions vacated.



CONVEYOR SYSTEM, reflecting proximity to long-term coal reserve, spans two highways

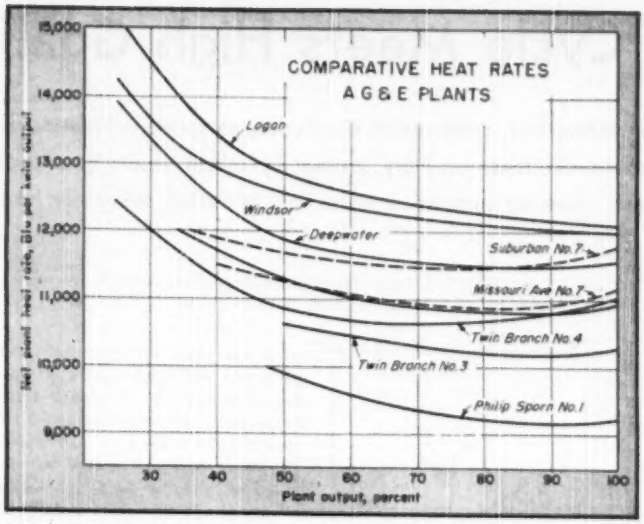


FIG 3—RESOLUTE PROGRESS reflected in heat rate achieved in 9 system plants beginning with Logan's 12,300 and culminating in Philip Sporn's expected 9,400 Btu per net kwhr

Substantiating Operating Results . . . Unit No. 1 of the Philip Sporn Plant was first synchronized and started supplying power to the system at 8:48 AM, Thursday, Nov. 24, 1949. A load of 20,000 kw was maintained on the unit for approximately 8 hr and during the next 24 hr the load was gradually increased to 60,000 kw, with the generators operating in air. This operation was maintained for a trial period of four or five days.

During this time all the feedwater heaters were placed in service. The evaporators were set up for maximum production of distilled makeup in order to accumulate a reserve for the commercial starting of the unit. Also during this period the boiler which was started with treated river water was operated at 1,000 lb pressure in order to reduce the possibility of carrying over silica to the turbine until the water conditions in the boiler were improved.

The unit was removed from service after the peak load on Nov. 28 as planned in order to complete necessary construction work, balancing of the turbogenerator sets, and the testing and filling of generators with hydrogen.

The unit was returned to service on Saturday, Dec. 10, and the load was increased over the weekend to 140,000 kw on Monday morning and to a gross generation of 150,000 kw for Tuesday morning load which is the system peak day. This load increase was accompanied by an increase in steam pressure and leveling off of steam temperatures so that at 150,000 kw, output, the design conditions of 2,000 psi and 1,050 F at turbine inlet were realized, and 1,000 F reheat temperature to the low pressure unit was obtained.

From a construction and design standpoint there are a number of minor corrections which operating experience has indicated as necessary and which will be carried out on the turbine and boiler equipment at the convenience of system load schedule. None of these problems is of a fundamental nature.

In particular a most satisfactory performance has been turned in by the centralized control facilities, and a number of plant shutdowns, including one or two under emergency conditions, have proved the anticipated simplicity and the value of the remotely operated devices for quick restarting of the plant. In the matter of special provisions for protection of those features of the reheat cycle which are supposedly "endangered" during tripouts, recent experiences have again demonstrated a complete absence of situations that would require special attention.

Performance of the unit is furnishing ample grounds for the belief that full realization of the theoretical bogevs will be achieved. The weighted average heat rate for the period from December 15, 1949, to April 12, 1950, gives 9,411 Btu per net kwhr generated. During this interval the plant took in its stride a number of shutdowns, and a period of operation with poor quality coal during the coal strike, that prevailed in the first quarter of the year, and also a period of operation with some or all high pressure feedwater heaters out of service for repairs. One check run at constant gross generator output of 151,000 kw gave the following results:

Auxiliary power: 8,000 kw or net generator hourly output 143,000 kw

Coal rate: 0.8344 lb per kwhr; Btu per lb of coal: 11,129

Heat rate: 9,286 Btu per kwhr

Boiler efficiency: 89.85

Thermal efficiency: 36.77

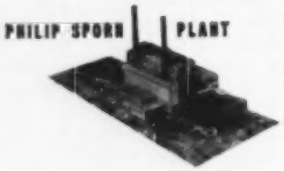
To measure the maximum peak capability the unit was operated for three consecutive hours with a gross hourly generation of 161,000 and auxiliary power consumption of 8,000 kw per hr. Under this condition the generators were operating under 25 lb of hydrogen pressure.

Comparative Data for Nine AG&E Plants at Full Load

Plant	Logan	Windsor	Twin Branch 4	Mo. Ave 7	Subur-ban 7	Tidd 2	Deep Water	Twin Branch 3	Philip Sporn
Cycle	Top	Top	F.E.	F.E.	F.E.	F.E.	Reheat	Reheat	Reheat
New Plant Output, Kw	90,750	154,000	98,950	33,100	39,800	103,400	50,000	71,800	143,750
Throttle Press, psia	1,265	1,265	1,275	1,315	1,315	1,275	1,215	2,415	2,015
Throttle Temp, F	925	925	950	1,000	1,000	925	725	940	1,050
Cross Over or Reheat Pressure, psia	200	240	105	.....	.....	.....	375	390	406
Temperature, F	510	540	424	.....	.....	.....	750	900	1,000
Condenser Press, in. Hg	1.5	1	1	1	1	Var.	1	1	Var.
Circ. Water Temp, F	Var.	Var.	Var.	Var.	47 F WB*	66	Var.	Var.	69
Boiler Eff., %	86.4	85.4	85.2	86.9	83	87.9	86.5	85.5	90.3
Make Up, %	1.15	3.1	2.25	4.3	4.3	1.5	1.25	1.1	1.5

* Cooling towers used, wet bulb.

Sporn Heat Cycle Meets High Goal



Seven extractions, compression distillation, complete deaeration, no induced-draft fans, auxiliary savings by reheat result in over-all thermal eminence without excessive cost in outlay, upkeep or labor

THEODORE BAUMEISTER, PROFESSOR OF MECHANICAL ENGINEERING, COLUMBIA UNIVERSITY, AND CONSULTING ENGINEER, AMERICAN GAS & ELECTRIC SERVICE CORP

PHYSICAL LOCATION of the Philip Sporn plant (1) near the center of the integrated system of the American Gas & Electric Co, (2) in an area with substantial coal reserves and (3) on a site with ample circulating water favored the choice of a power station of high efficiency in the use of fuel provided the good thermal economy could be obtained without sacrifice of operating reliability and without excessive investment. No fetish was to be made of low heat rate, except insofar as the resulting plant achieved gains in investment, maintenance and operating labor.

In the determination of the pressure and the temperature to be employed and to assist in the evaluation of the reheat vs the non-reheat cycles several comparative arrangements were analyzed. These were all predicated on the use of the largest practical size for the turbine-generator and for its accompanying boiler so as to take maximum advantage of (1) the best mechanism efficiencies inherent in these large units and (2) the most effective use of operating labor.

In the preparation of the cyclic arrangements which would give a true, actual comparison—rather than a theoretical or ideal analysis—it was necessary to eliminate as far as possible the otherwise confusing details such as variations in feed water temperature, number of stages of feed heating, feed pump locations in the cycle, reheat pressure, reheater pressure drop, drain coolers, drip pumps, makeup provisions, gland sealing provisions and the many other similar items which can so easily cloud the basic issue. The results of these attempts to bring the cycles, which were studied, to a rational comparative footing are shown partially by the data of Fig 4. Basic thermal performance of the reheat and non-reheat cycles can be read with reasonable assurance of comparability from these curves.

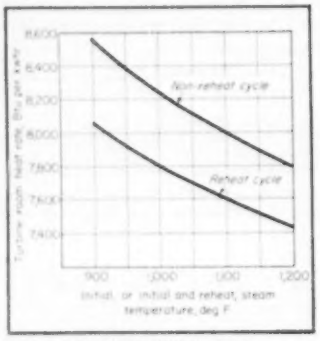


FIG 4—COMPARATIVE turbine room heat rates for reheat and non-reheat cycles on 150-Mw units. Constant throttle pressure 2,000 psi but variable steam temperatures. Allowances included for boiler feed pump

Factor of Fuel Cost . . . Before the war a 1,400-psi boiler and topping turbine installation was chosen for the Logan Plant where coal was then costing 75¢ a ton. The wisdom and courage of that decision are amply demonstrated by the present day fuel price of nearly $5.00 a ton at the same location. In the course of the studies which were made to reach a rational conclusion on the Philip Sporn units some of the comparable figures are given in Table 1. These figures were prepared in 1943 and were based on a coal price of 10 to 12¢ per million Btu.

Heat Balance . . . The basic thermodynamic reheat-regenerative cycle which was ultimately resolved for the plant is shown schematically by Fig 5. The over-all performance data of the plant are plotted as a heat rate curve in Fig. 6. The thermal performance on a net plant send-out basis, and under the estimated "average" conditions with 69 F circulating water temperature is estimated as 9,200 Btu per kwhr in the high load ranges. The curve of Fig 3 shows that the heat rate, even at loads as low as 50%, will not rise above a value of 10,000 Btu per kwhr. The significance of these economy figures may better be appreciated by comparison with other plant data. It was only a few years ago when the 2,400 psi, 940 F, 900 F Unit No. 3 reheat installation was made at the Twin Branch Plant and despite all efforts, at that time, it was not possible to break through the figure of 10,200 Btu per kwhr. The Philip Sporn Plant represents in effect a progressive step, in less than 10 years time, of a fuel reduction of 10% in the thermal requirements for the production of a saleable kilowatt hour. These performance figures doubtless make this plant the most efficient steam station yet projected or constructed.

Major Contributions . . . The heat balance diagram of Fig 5 reflects many elements worthy of particular recognition, as follows:

1. Seven stages of extraction feedwater heating are employed. The two, last, high pressure heaters include integral drain coolers. Cascading, without subcooling, is used on the remaining low pressure, closed, heaters, except for the 18th stage. Here a drain pump returns the condensate to the main feed line. The first heater, because of its low operating absolute pressure, is drained directly to the main condenser. The temperature rise of the water in each of the successive heaters is by no means alike. The crossover heaters carry at least twice the load of those

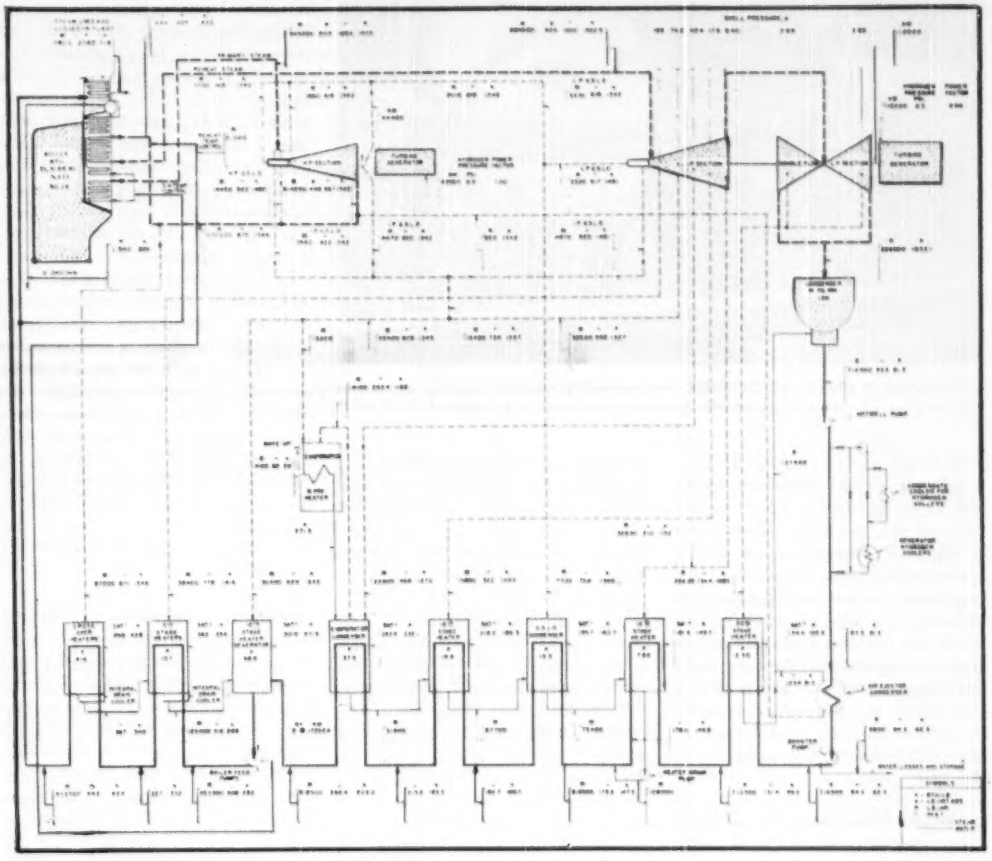
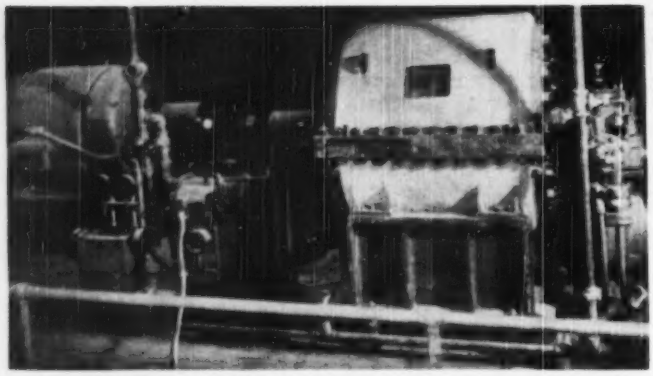


FIG 5—HEAT BALANCE for 150-Mw unit at 2,000 psi and 1,050 F reheat for full load operation with 9,200 Btu net performance; constant circulating water temperature, 69 F; seven stages of extraction; compression distribution incorporates heat pump gains

next immediately below (the 5th stage). This unequal division of the temperature rise stems from the thermodynamic reversibility considerations of high pressure turbine exhaust steam, before reheating, as contrasted with steam from the fifth stage of the low pressure turbine, following the re-superheating operation. The customary equality of temperature rise among feedwater heaters is thus altered for specific advantages.

Gland Leakage Allowances . . . 2. Separate shells have been provided for the makeup evaporator condenser and for the gland steam leak-off condenser because of the consequent improvement in plant heat rate. The numerous gland leakage quantities, originating in the sources shown on the heat balance diagram, are made purposely larger than the manufacturer's guarantees to allow for the usual wear and operating variations and to avoid unreal approaches to the problems of handling leakage which is larger than expected.

Compression Distillation . . . . 3. Loss of steam and water from the system has been based upon an estimate of 1.5% of throttle flow at full load conditions. This, from previous experience, should meet the needs of the plant in ample manner. The makeup is provided through (1) a conventional evaporator on the 10th stage extraction, as shown, or (2) a motor driven compression distillation unit. The latter was chosen, for initial use in this plant, as an answer to the common complaints which are often made about the inadequacy of makeup capacity, particularly at partial loads on the main unit. With the usual evaporator, a shift can be made to higher or lower bleed points at lighter loads on the main generating unit, but the thermal sacrifice is considerable. A thermo-compressor or heat pump was therefore specified to meet this sort of criticism and to introduce other inherent advantages. A compression distillation system can be operated from the station bus or from the transmission system with excellent over-all thermal results and with complete independence of the load on the main unit. The coefficient of performance for this heat pump is of the order of 15 to 20 which is the over-all equivalent of the thermal re-



COMPRESSION DISTILLATION UNIT, motor-driven, supplements make-up capacity of evaporator on 10th stage extraction with heat-pump coefficient of performance of 15 to 20

sults which could be expected with a quadruple effect evaporator plant. The cycle for this compression distillation unit is shown schematically in Fig 7. A motor driven compressor takes vapor from the shell of the evaporator, raises its pressure and delivers it to the coils in the evaporator. The latent heat of condensation serves to supply the necessary latent heat for evaporation. A series of heat exchangers are necessary as shown to recover the full complement of heat and maintain the operability of the unit.

Complete Deaeration . . . 4. Complete deaeration of the feed water was recognized as a basic requirement for the cycle and as a consequence no water is allowed to enter the economizer which has not been degasified immediately before its introduction. A "deaerating hot well" (0.03 cc per liter oxygen) is supplied on the main surface condenser. This is supplemented by a positive pressure deaerator on the 10th stage extraction line. Drips from the high pressure heaters are cascaded to this shell for deaeration and makeup supply is separately degasified before introduction to the evaporators. This arrangement gives maximum assurance of complete deaeration and simultaneously effective heat economy in the power cycle.

5. All pumps in the feed system are motor driven at constant speed. The complications and expense of speed control were not considered to be justifiable in the light of the expected high load factor operation.

Recovery of Generator Heat . . . 6. Efforts are made to recover heat from the generator windings but whenever the condensate temperature leaving the condenser hot well exceeds a predetermined maximum value (90 F), service water or circulating water is employed with heat exchangers to hold the temperature to the desired value to realize the thermal advantage of heat recovery.

7. In the layout of the plant heat cycle it is quite usual to place greater emphasis on the turbine room, its auxiliaries and heat traps, than on the boiler room. This procedure is not always the most effective. The best over-all thermal performance will result from a mutual crediting and debiting of all boiler and turbine room components. The selection of the final feedwater temperature well

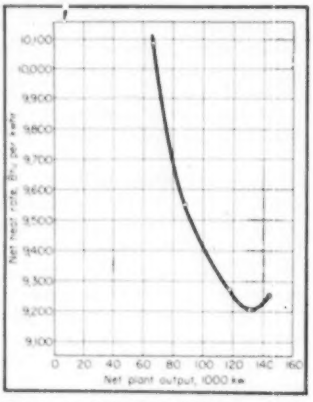


FIG 6—RANGE OF LOADING for half to full value reflects under 10% spread in thermal efficiency for over-all performance

illustrates this situation. In the Philip Sporn cycle the final feed temperature has been purposely limited to a value less than 443 F at the heaviest load. The turbine room cycle in itself might thermally indicate a value somewhat higher. The gain in boiler efficiency, however, with lower feed temperatures was evaluated to give best over-all thermal economy with the selected temperature. Similarly the boiler efficiency has been specified at 90% which can be realized with the specified feed temperature. The gross boiler efficiency versus the net value has likewise been recognized in the conclusion to use forced draft, exclusively, instead of the more customary arrangement of two fans with balanced draft. The substitution of the forced draft fan for the combination of forced and induced draft is estimated to result in a power saving of the order of one half of one percent or 50 Btu per kwhr.

Reheat via Cross-over . . . 8. The cross compound turbine has been chosen to take best advantage of high internal efficiencies. The crossover between the 3,600 and 1,800-rpm elements is combined with the reheating function. The pressure at which this is effected is somewhat different from what would be dictated by the thermo-dynamics alone but it results in a better capacity split and in more economical sizing of the reheater piping and of the reheater itself. The internal efficiency of the turbine set is high by reason of the large flow passages which are a necessary accompaniment of large capacity. The high reheat temperature—1,000 F at 400 psi—also makes a substantial contribution to high internal efficiency by minimizing the moisture loss in the exhaust end of the low pressure turbine. The final moisture content has been limited to 6-7%, at full load, which is considerably lower than prevails on most condensing turbine exhausts. The low pressure turbine element is, in turn, made tandem compound with a double flow exhaust section. The latter reduces the leaving losses and thus serves greatly to improve heat rate. The condenser end of a modern power plant seems often to be relegated to a somewhat minor position probably because it does not contain the

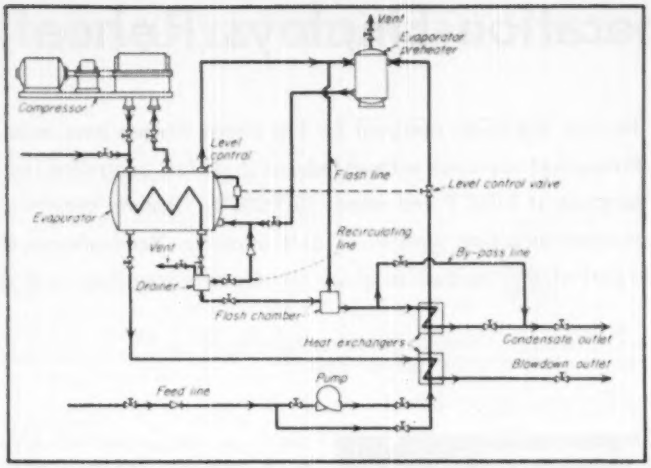


FIG 7—COMPRESSION EVAPORATION CYCLE minimizes thermal sacrifice in affording adequacy of make-up supply. System can be operated independently of main-unit load

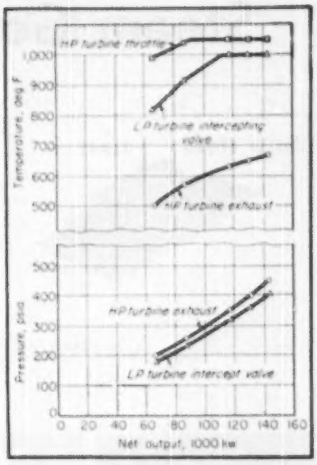


FIG 8 — SUBSTANDARD temperatures cause resort to attemperation near full load

glamor of the high pressure and high temperature features. Yet, it is still the most valuable part of a steam power plant and its full potentialities should not be neglected. Exhaust losses, with the double flow LP element were accordingly reduced.

Reduced Auxiliary Power . . . .

9. One of the minor advantages of the reheat cycle is represented in the reduction of auxiliary power.

10. Much attention was devoted to the thermal losses which would obtain on the plant if the primary and reheat temperatures were allowed to deviate from the specified base values of 1,050 F and 1,000 F respectively. This situation can become especially bad at partial loads if the temperatures are allowed to drop. The inherent design features and operating characteristics of the boiler, the high pressure turbine and the low pressure turbine had therefore to be studied individually and jointly. The ultimate conclusion is reflected in the data of Fig 8 which shows the steam temperatures at several vital points in the cycle. These are the conditions under which the actual installation must run. The curves show the magnitude of the temperature variations. These, typically, at half load, are 1,010 F primary temperature and 860 F reheat temperature. These values are respectively 40 degrees and 140 degrees substandard. To meet the specification of Fig 8 it is necessary to resort to some attemperation at or near full load. Attemperation at the primary level of 2,000 psi offers no thermal disadvantage. However, the attemperation of reheat steam is serious because every pound of water used for this purpose is in reality steam which is employed on a 400-psi cycle instead of a 2,000-psi cycle. Thus the reheat attemperation of 21,000 lb at full loads as shown in Fig 2 sacrifices 30 Btu per kwhr. This loss was considered acceptable at full load in order to sustain the plant efficiency at loads down to a value of 50%.

11. Inquiry is often directed to the basic worth of the several operating variables which are normally encountered in the routine operation of a high pressure, reheat, steam plant. The values of primary temperature, reheat temperature, throttle pressure, reheater pressure drop, feedwater temperature, and condenser vacuum come within this specification. Some approximate over-all figures, which can be considered as representative of the Philip Sporn units, are given in Table 2.

TABLE 1—Comperative Returns on Alternate Heat Cycles

Line	Case	1	2	3	4
1	Throttle pressure, psia	1,315	1,315	1,815	2,315
2	Throttle temperature, F	1,000	1,050	1,050	1,025
3	Resuper heat temperature, F	None	1,050	1,050	1,025
4	Resuper heat pressure, psia	None	288	411	596
5	Condenser pressure, in. abs	1	1	1	1
6	Boiler feed temperature, F	500	500	525	525
7	Comparative overall net plant heat rate, Btu per kwhr	10,510	9,800	9,610	9,520
8	Price for boiler and turbine generator	$4,955,000	$5,113,000	$5,386,000	$5,568,000
9	Increment in boiler and turbine price, $	Base	$158,000	$431,000	$613,000
10	Savings in heat rate, Btu per kwhr	Base	710	900	990
11	Estimated Annual fuel savings, $ per year	Base	$99,400	$126,000	$138,000
12	Gain or loss in plant capacity, Kw	Base	+1,340	+300	−700
13	Increment value of capacity @ $50 per kw, $	Base	$62,000	$15,000	−$35,000
14	Remaining increment to be absorbed by fuel saving, $	Base	$96,000	$416,000	$648,000
15	Annual return on increment investment with credit for increased capacity, %		103	30	21
16	Annual return on increment investment without credit for increased capacity, %		63	30	23

TABLE No 2—Approximate Correction Factors For Over-all Station Heat Rate

Initial and reheat steam temperatures, each changed the same amount—
2.5 Btu per kwhr per degree of combined initial and reheat temperature

Initial steam temperature, no change in reheat steam temperature—
1.3 Btu per kwhr per degree of steam temperature

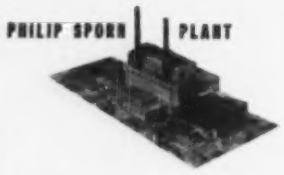
Reheat steam temperature, no change in initial steam temperature—
1.2 Btu per kwhr per degree of reheat temperature

Initial steam pressure—
0.3 Btu per kwhr per lb of initial pressure

Feedwater temperature—
1.5 Btu per kwhr per degree of feed temperature

Condenser Vacuum—
200 Btu per kwhr per inch of vacuum

Steam Generation Employs Reheat,



Furnace and boiler designed for 1½ billion Btu per hour input. Pressurized operation without induced draft fan, controlled temperature of 1,050 F and reheat to 1,000 F. Remote control of starting including ignition of coal burners. Recirculation of a part of the combustion gases for steam temperature control

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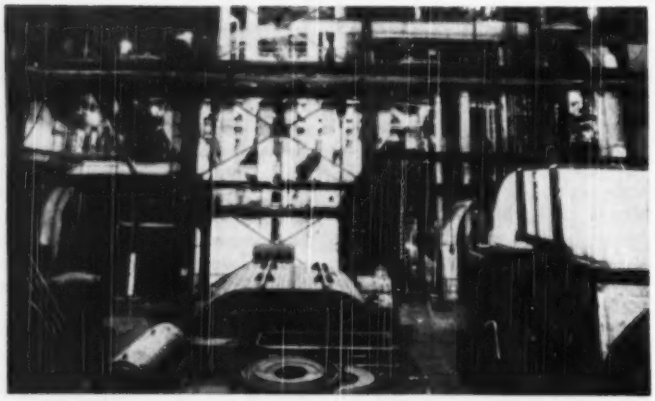


HIGH PRESSURE UNIT (left) returns exhaust steam to superheater section for reheat in cross-over to twin LP units, right. Parts for second pair of units are in middle foreground

OPERATING RECORD of large single boiler units on the AG&E system gave adequate confirmation of the assumption that a single reheat type boiler designed for one and one-half billion Btu hourly heat input was a practical consideration. With this decision made it was determined to exploit all the savings that installation of a single boiler unit offered. The plant layout reveals the surprisingly compact arrangement of this equipment in spite of its really immense proportions.

Boiler and Furnace . . . A single pulverized coal-fired radiant boiler (Fig 10) serves each turbogenerator set. Each has a continuous rating of 930,000 lb of steam per hour at 2,000 psi and 1,050 F at turbine stop valves. Integral convection reheater surface is installed in each boiler to handle 840,000 lb of steam per hour, raising the temperature from 652 F at 430 psi to 1,000 F at 380 psi. Feedwater temperature to the economizer at this load is 443 F and fuel heat input is 1,300,000,000 Btu per hour.

The units are designed for 2,300 psi working pressure and utilize natural circulation. Water is supplied directly from the main drum through a multiplicity of unheated tubes uniformly distributed across the drum length to the lower water-wall supply headers. Steam and water discharge from the generating circuits is again uniformly distributed along the drum, and effective separation is accomplished by the cyclones and scrubbers located in the single drum. This drum has a shell which is 60 in. OD, 6¼ in. thickness, and 56 ft, 8 in. over-all length and weighs 135 tons.

The furnace is of the radiant type with 3 in. OD tangent bare tubes which constitute the entire steam generating circuit. Maximum heat absorption surface is obtained economically by the installation of a furnace division wall which utilizes both wall faces for maximum cooling surface. The furnace volume and projected surface are 79,800 cu ft and 17,000 sq ft, respectively, up to the superheater inlet. Resulting liberation and absorption rates are conservative and are designed to permit satisfactory operation with a wide range of coal ash fusion temperature characteristics.

Superheater and Reheater . . . Main and reheat superheaters are located in a single vertical convection pass. All tubes are horizontal for complete gravity drainage. The various portions of main superheater are interspersed with the reheat superheater in the gas flow path to give the most practical arrangement of these surfaces and with added recognition of the requirements for protection of the reheater during starting and during interruption of steam flow to turbines resulting from closure of turbine control valves or stop valves.

No special provision is made for steam cooling of the reheater during starting or during turbine steam flow interruptions. The design permits starting up from cold with continuous pulverized coal-firing, supplemented by ignition oil torches for stable operation. It also provides a very important element of flexibility when the generator output is interrupted and the cause is not immediately known. Under this condition

Pressurization, Gas Recirculation

the superheater safety valves will open to protect the superheater from overheating but there will be no steam flow through the reheater. Continued firing at a rate equivalent to 25% full capacity can be maintained.

Superheat Controlled . . . An automatic arrangement is provided in the controls so that upon interruption in steam flow a number of pulverizers are tripped out of service and an immediate reduction in firing rate to approximately 25% capacity is established. This permits the control operator to appraise the situation and either to re-establish generator output or to complete the shutdown of the unit. In the event it is possible to re-establish output, this is then done from a relatively high fuel input and temperature level and therefore with minimum thermal shock to the high-temperature portions of the superheater, reheater, piping, and turbines.

Both main and reheat superheaters are designed for some excess surface to provide means for control to the design level at high loads.

Attemperator Provisions . . . Spray attemperators are used for controlling both superheater outlet and reheater outlet steam temperatures from 87% load up to full load. Sources of spray water and relative locations of attemperators are shown on the steam flow diagram, Fig 11.

Water for the two identical superheater attemperators is taken from the boiler feedwater header beyond the high-pressure feedwater heaters. One attemperator is located in each of the two steam pipes connecting the primary superheater outlet header to the secondary superheater inlet header. These two steam pipes are crossed so as to equalize any unbalance in heat transfer in the boiler caused by unequal firing, localized slag deposits, or any other unusual operating conditions which could unbalance gas flow or temperature to the two sides of the convection pass.

Water for the two identical reheat attemperators is taken from the third stage of the boiler feed pumps and passes directly to the reheater steam inlet pipes without additional heating.

Design quantities of attemperating water at full load are 40,000 lb per hr at 443 F for the superheater and 21,000 lb per hr at 302 F for the reheater. Reheat attemperation is deliberately kept at a low level since attemperation represents a thermal loss because steam is generated which does not pass through the high-pressure turbine element.

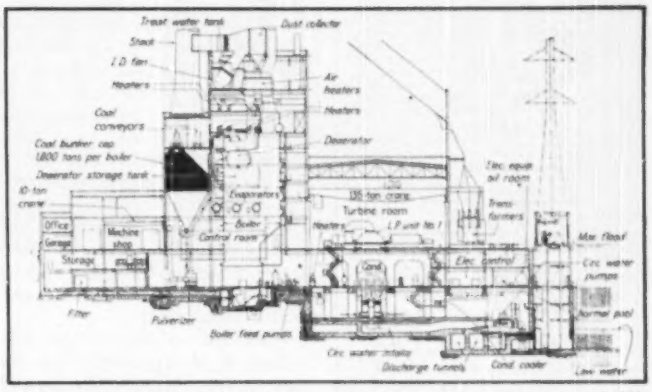


FIG 9—PHILIP SPORN PLANT has transformer bank and turbine room toward Ohio River and boiler room on the landside. Control for pairs of units centered between boilers

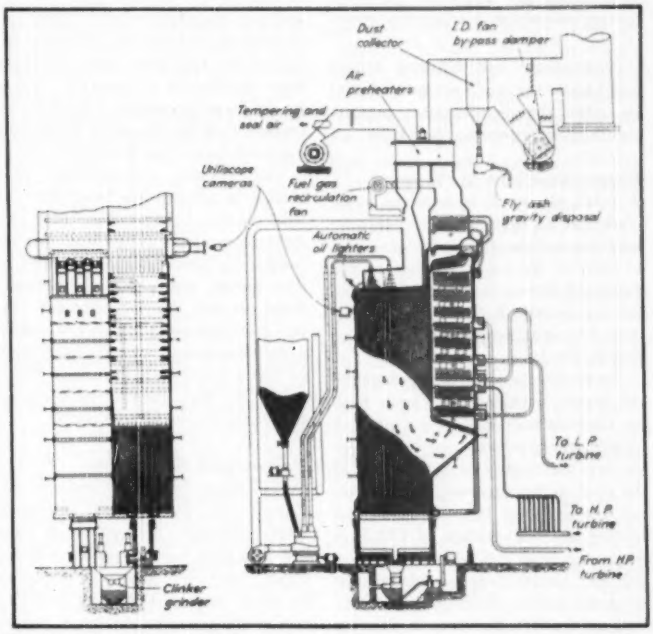


FIG 10—RADIANT FURNACE has division wall; main and reheat superheaters are interspersed in single vertical convection pass. Tubes are horizontal for gravity drainage

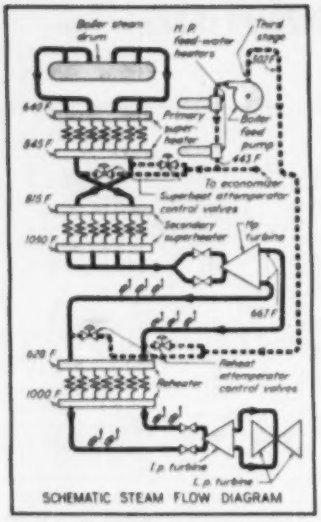


FIG 11—SEPARATE attemperator valves for superheat and resuperheat supplement flue gas recirculation in temperature control

Superheater and reheater tubing and header materials are quite varied to meet the temperature requirements most economically (Table I).

Economizer and Air Heaters . . . A relatively small economizer is included as an integral part of the uptake convection pass. It was sized to provide the small amount of gas cooling between the superheater and the air heater, both of which have their terminal temperatures approximately fixed.

There are two large regenerative air heaters included to provide high air temperatures, 550 F, for most effective drying of wet coal in the pulverizers and improved combustion of the coal in the furnace. These heaters are designed to provide a final leaving gas temperature of 233 F at maximum load and with 80 F entering air. Under these conditions, the expected boiler efficiency with Ohio coal of 11,400 Btu per lb heating value is 90.3%. Preliminary tests have indicated this efficiency is being fully realized along with other significant operating conditions.

Coal Preparation and Burning . . . Raw coal from the bunkers is fed by gravity directly through short, expanding conduits to the pulverizer feeders which are located on the main operating floor for ready accessibility for cleaning attention or maintenance. From these feeders, coal drops vertically and directly into the top of each of the five pressure pulverizers. Each pulverizer has a capacity of 15 tons per hr of specified coal and under normal coal conditions design capacity of the unit can be carried with four pulverizers, thus releasing one pulverizer for maintenance or adjustment during normal daytime working hours. Subnormal coal conditions generally require that all five pulverizers be operated, and under such conditions extremely poor grades of coal can be utilized without sacrifice of unit capacity due to pulverizer limitations.

Pulverized coal from the five pulverizers is blown directly into the burners, two per pulverizer, located in the furnace roof and firing directly downward into the furnace. Burners are of the multiple tip design and provide effective mixing and turbulence of coal and air. Vertical firing of this type also promotes maximum utilization of furnace volume by the flame by virtue of the inherent tendency of the flame to mushroom outward during the downward travel.

The burners are remotely controlled in all respects from the control room. Automatic fuel oil lighters, remotely controlled, provide means for instantaneous ignition of coal during any phase of operation from normal starting through normal load manipulation and for emergency shutdown. Visual observation of flame from each burner is transmitted to the operator in the control room by wired television.

Pressurized Operation . . . The Philip Sporn Plant boilers are designed for forced-draft operation only, although induced draft fans are provided for alternative conventional "suction" operation. Decision to retain suction operating facilities was made to insure maximum capacity availability of this large unit during the early period of "shaking down" the pressure operation elements. The suction operation elements can be readily isolated and later removed and reused as reliable pressure operation is developed.

The pressure operation feature is not entirely new but the present application represents a decided step in size of unit and gas pressure level to which it is applied.

Principal Advantages of Pressurization . . . 1. Design for pressure operation must provide a very tight and leak-proof setting to prevent outward escape of flue gases. This insures operation with minimum excess air since all air is available to the burners for combustion. Conventional units generally have from 10 to 25% air infiltration beyond the burners, thus contributing a corresponding loss in efficiency to the extent of from 0.6 to 1.5% of fuel fired.

2. With pressure operation, the forced draft fan handles a smaller volume of air than the combined volume of forced and induced draft fans for suction operation. This represents a reduction in auxiliary fan power of approximately 800 kw, or 0.5% of fuel fired, for the units when operating at peak load.

3. Eventual omission of induced draft fans will eliminate the substantial maintenance usually associated with these fans.

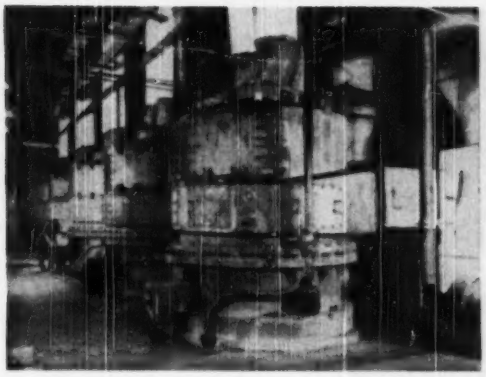
4. Elimination of induced draft fans will result in a space saving of appreciable magnitude. This might be variously estimated at from 0.5 to 1 cu ft per kw capacity.

5. Elimination of induced draft fans from designs will result in a direct saving in initial investment in fans, drives, and accessories. This item might be estimated at from $0.25 to $0.50 per kw capacity.

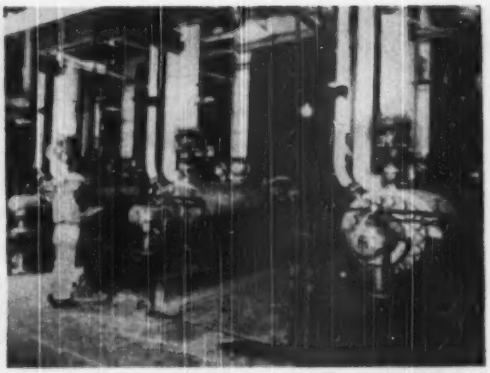
6. Pressure operation permits combustion control application to a single fan only instead of simultaneous application to two fans having dissimilar functions.

The design for pressure operation necessitated some very positive provisions to eliminate usual points of leakage. The furnace casing is of the skin type and is completely welded for tightness but sufficiently flexible for thermal expansion. Application of insulation and plastic finish outside the casing provides for effective reduction of heat losses from the unit.

Recirculation of Combustion Gases . . . Facility for recirculating a portion of the flue gases (Fig 10) is an entirely new concept and principle for maintaining superheat and reheat steam temperature at a high



PULVERIZERS are five in number for two boilers and each has a capacity of 15 tons per hour. Four in operation normally will suffice



BATTERY of motor-driven boiler feed pumps serves the boilers at 2,300 psi. Temperature of the feedwater to the economizer is 443 F

level during partial load operation and without increasing gas temperatures in any part of the system. A part of the gases is withdrawn from beyond the economizer and raised in pressure by the recirculating fan and returned to the secondary air duct ahead of the burners for direct mixing with the combustion air. A similar method, wherein the gas is returned to an appropriate point in the furnace without premixing with the air, might also be employed.

The effect of flue gas recirculation is primarily to provide for less heat absorption in the furnace and more in the convection pass. The greater gas weight and total heat (not temperature) entering the convection pass afford means for greater heat absorption by the convection surface.

TABLE I—Materials Employed in Superheater and Reheater Sections of Boiler

PRIMARY SUPERHEATER	**MATERIAL SPECIFICATION**	
Inlet Header	SA-106 Gr. B	C-Steel
Tubing 47 rows	SA-210	C-Steel
1 row	SA-209	C-Mo Steel
1 row	SA-213 Gr. T 22	CR-Mo Steel
Outlet Header	SA-280	CR-Mo Steel
Attemperator Piping	SA-280	CR-Mo Steel
SECONDARY SUPERHEATER		
Inlet Header	SA-280	CR-Mo Steel
Tubing 20 rows	SA-213 Gr. T-22	CR-Mo Steel
4 rows	SA-213 Gr. T-19	Stainless Steel
Outlet Header	SA-213 Gr. T-21	CR-Mo Steel
REHEATER		
Attemperator Piping	SA-212 Gr. B	C-Steel
Inlet Header	SA-106 Gr. B	C-Steel
Tubing 16 rows	SA-210	C-Steel
2 rows	SA-209	C-Mo Steel
6 rows	SA-213 Gr. T-14	CR-Mo Steel
4 rows	SA-213 Gr. T-22	CR-Mo Steel
Outlet Header	SA-158 Gr. P3b	CR-Mo Steel

Flue gas recirculation becomes particularly advantageous with units required to produce both high initial and reheat steam temperatures with all or a predominance of convection superheating and reheating surface. At partial loads it has a very pronounced effect in maintaining high steam temperature levels and correspondingly lower unit heat rates at a very small expenditure of off-peak auxiliary power for the fans. Preliminary operating data for the first Philip Sporn unit indicate the following actual conditions:

% Max. Load	*% Gas Recirculation*	*Heat Rate Gain, % Gross—Net*	
100	0	0	0
75	7	1.5	1.4
67	10	2.0	1.9
50	17	2.4	2.2

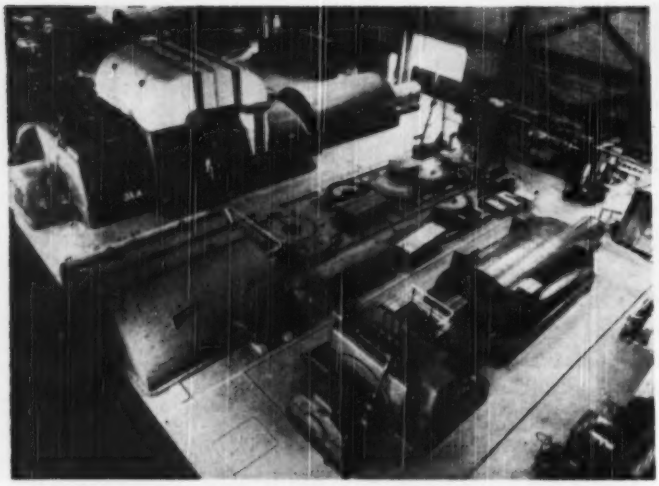
Steam Soot-blowers . . . Each boiler unit is equipped with fourteen retractable-type soot blowers, all of which are located in the convection pass. These blowers are of three specific types: (1) full retracting, (2) partial retracting with blowing nozzles at the inlet and end of the partially inserted lance tube, and (3) telescopic elements where external clearance and temperature level prevented use of the full or partial retracting-type blowers. Steam, originating from the boiler drum and reduced to 600 psi, is used as a blowing medium and all blowing is conducted from the central control room from the automatic sequential soot-blowing control panel. The air preheater soot blowers are similarly automatized for remote operation from the central control room.

Ash Removal . . . Each unit is provided with a mechanical dust collector. This collector is made up of a total of 6,240 aluminum 3-in., cyclone-type collecting elements. Fly-ash is removed continuously from the collector hoppers by feeder valves which deliver it to water-mixing chambers. The mixture is then flushed through a single pipe to the disposal area where the ash and water are separated by sedimentation. This entire collection and disposal system represents one of the simplest forms of handling such materials and requires minimum operating attention and expense.

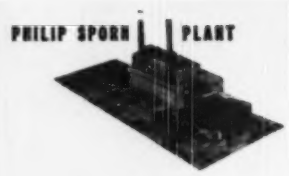
Dust collectors are supplemented by a high-level discharge stack serving each unit. Each stack is 150 ft high above the top of the plant and 295 ft high above grade. The high-level, high-velocity discharge of residual gases provides for adequate and effective dispersion for maximum benefit in nuisance elimination.

Furnace ash is collected in two refractory-lined ash hoppers directly beneath the water-cooled furnace hoppers. The ash hoppers are periodically sluiced to a clinker grinder and thence to a common cast-iron sump from which the ash is immediately pumped to the disposal area.

The ash hoppers have water seals to provide tightness during either pressure or suction operation. The entire disposal installation is thus of the closed type permitting ash removal, during positive pressure operation, without exposing any portion of the system to hot gases.



TURBINE UNIT comprises high pressure machine with reheat to 1,000 F in crossover to low-pressure unit. Systematically arranged parts are for second unit in the background



Turbine, Condenser and Piping Fit Objectives

Cross-compound turbine-generator unit with 1,000 F on 1,800-rpm element. Weir in discharge tunnel saves foundation costs. Pressure deaeration. Bored forging for steam header. Turbine stop valves also serve boiler

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EACH OF THE 125,000 rated kw cross-compound type turbine generator units consists of a 35,000-kw, 3,600-rpm, single-flow, high-pressure turbine and generator, and a 90,000-kw, 1,800 - rpm, tandem - compound, double-flow low-pressure turbine and generator.

Steam at 2,000 psi and 1,050 F temperature enters the high-pressure turbine (Fig 12) through 8 control valves located on both the upper and lower turbine shells. The steam is expanded through this 10-stage turbine and exhausts at approximately 350 psi at full load. It is then returned to the boiler where it is resuperheated to 1,000 F and enters the 1,800-rpm, tandem-compound, double-flow, low-pressure element (Fig 13). This turbine consists of an 18-stage single-flow or intermediate-pressure section—followed by a 4-stage double-flow section. The machine is provided with seven points of extraction for feedwater heating —one from the exhaust of the high-pressure turbine and the remaining six from the low-pressure turbine.

These units are designed for operation at the highest combination of pressure and temperature so far employed and are the most efficient steam-electrical units in service.

Double Shell Construction . . . The 3,600-rpm high-pressure turbine, because of the relatively small wheel diameters, is readily adaptable to the high temperature and pressure specified. A double-shell construction is employed with the inner shell supporting the nozzles and diaphragms. The annulus between the two shells is maintained at an intermediate pressure by steam supplied from a lower stage. This steam cools the outer shell and reduces the loading of the shells and bolting. The resultant thinner castings accommodate temperature changes more readily and without distortion.

1,000 F on 1,800-Rpm Machine . . . The resuperheated steam enters the low-pressure turbine at 1,000 F and is the first case where initial temperatures of this magnitude have been employed in a 1,800-rpm turbine. The wheels of the first 12 stages of the single-flow section are forged integral with the shaft, avoiding danger of loosening under rapid temperature changes. The wheels of the last six stages of this section of the turbine, however, are keyed and shrunk to the shaft, thus eliminating the necessity of making a long forging of larger diameter with its attendant possibility of improper working of the material.

The low-pressure double-flow section consists of four stages with all wheels keyed to and shrunk on the shaft. The cross-over between the single-flow and double-flow sections of the low-pressure turbine is proportioned and vaned for minimum small pressure drop.

Condensing System . . . The circulating water system is designed for a total flow of 1,500 cu ft per sec (675,000 gpm) for the ultimate plant of six units. A common screen house and discharge tunnel are provided for each two units. Because of wide variation in river level, screens are

extremely long—74 ft between shaft centers. A wooden sluice gate before each screen makes it possible to dewater the entire intake tunnel or remove any screen for repairs, while the unit remains in operation. A normally closed sluice gate, in the dividing wall between the screens for Units No. 1 and 2, can be opened to equalize flow to the two units when any screen is out of service.

Ice formation on or in front of the trash grille is prevented by warm condenser discharge water recirculated to the screen house intake through pipes in the partition walls.

Siphon and Seal . . . The tops of the condenser water boxes have been placed at an elevation equivalent to maximum siphon effect above normal pool in order to save foundation costs. Extreme low water may be as much as 15 ft below the normal pool, and during this time discharge sluice gates may be throttled to maintain siphon flow. Circulating water pumps are driven by two-speed motors to maintain full flow of water with the discharge sluice gates throttled.

A saving in construction cost was also made by installing the discharge tunnels above extreme low-river level and providing a weir in the outlet of the discharge tunnel to seal against air leakage into the condenser water boxes.

Feedwater System . . . Deaerated water from the condenser hotwell is delivered to the boiler by means of three sets of pumps in series, ie, the hotwell pumps, the condensate booster pumps, and the boiler feed pumps located in the feed heating cycles as shown in Fig 5. All pumps are constant-speed, motor-driven. One of the two single-stage, hotwell pumps delivers water to either of two two-stage booster pumps. The developed pressure on the latter is ample to deliver the condensate to the deaerator. Two of the three boiler feed pumps under the deaerator then raise the pressure to that dictated by the boiler.

Heat lost in the generator windings is recovered in the feed system for part of the year. A recirculating arrangement with supplementary coolers is used to avoid excessive winding temperatures during warm weather periods of poor condenser vacuum.

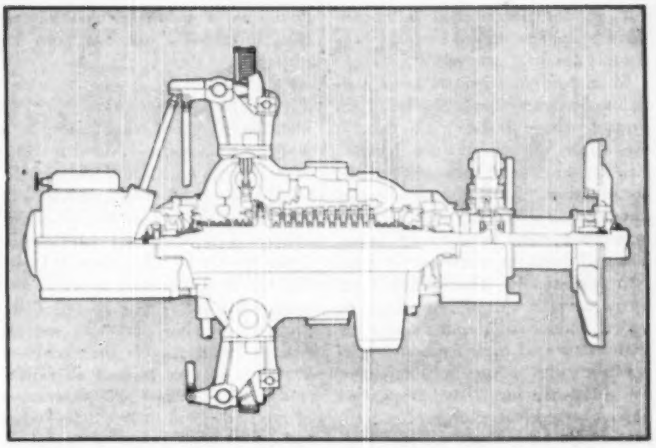


FIG 12—LONGITUDINAL SEMI-SECTION of 35-Mw 10-stage high pressure element of cross-compound unit. Steam enters through 8 control valves on upper and lower shells

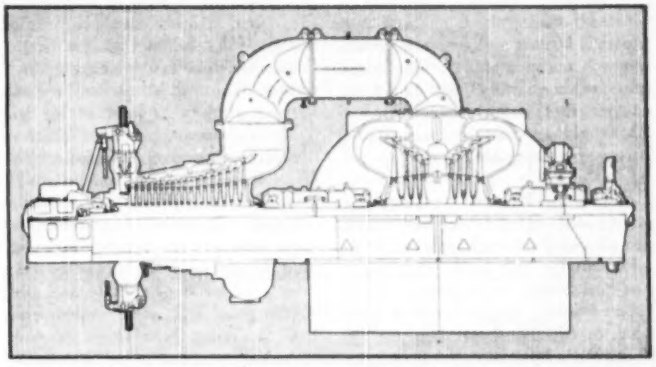
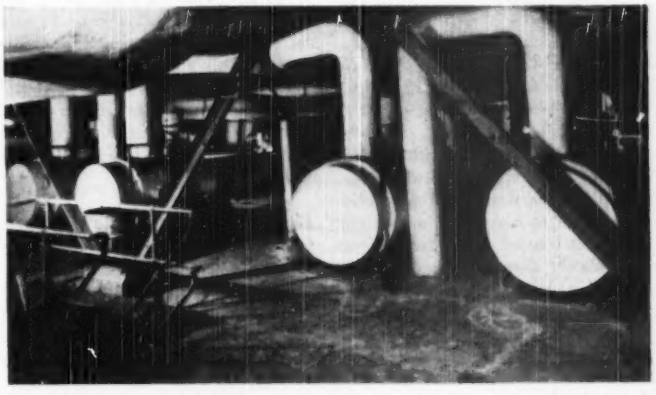


FIG 13—TANDEM COMPOUND double-flow 22-stage low-pressure element has single 1,800-rpm generator at right. The turbine has 7 points of extraction for feedwater heating



MAIN FEEDWATER HEATERS are horizontal 2-pass U-tube construction. High-pressure units are divided into two parallel banks, each bank comprising two heaters in series

Air ejector inter- and after-condensers are also served by main condensate for heat recovery.

Main feedwater heaters are classifiable by water pressure into two groups—above or below the deaerator—high- or low-pressure heaters. All are horizontal two-pass U-tube construction. Low-pressure heaters have arsenical copper and the high-pressure heaters have monel tubes. The high-pressure heaters are divided into two parallel banks, each bank operating as a unit of two heaters in series. This arrangement permits the maintenance of high feedwater temperature with minimum investment for high-pressure motor-operated valves, even during outage of a "lost" heater. At such times all the feedwater is passed through a single bank. Integral drain coolers are incorporated in the high-pressure heaters.

A positive pressure deaerator is located between the high- and low-pressure heaters and serves to reduce the oxygen content to the lowest measurable quantity (less than 0.005 cc per liter). A storage tank of 22,000-gal capacity is immediately below each deaerator.

Boiler Feed Pumps . . . Three constant speed motor-driven feed pumps are provided for each unit, with two adequate for full load. The pumps are horizontal, single-suction, drum-type of eleven stages, rated at 1,100 gpm, or 510,000 lb per hour, at 304 F against a head of 6,000 ft or 2,400 psi. They have monel metal shafts and double casings, an inner one of ring segments, alloy steel and an outer one of barrel-type, forged carbon steel. Each pump is driven by a 2,000-hp, 3,570-rpm, 2,300-v induction motor. There is a takeoff at the third stage of each pump to furnish 50 gpm of reheat attemperating water at 650 psi pressure.

Each unit is equipped with one 22,500-lb-per-hr make-up evaporator, served by 10th stage bleed and delivering vapor, to a separator evaporator condenser located in the feed circuit immediately ahead of the deaerator. Treated make-up is supplied to the evaporator preheater for degasification to 0.005 cc of oxygen per liter and is then delivered to the shell of the bowed-tube type evaporator for the production of vapor with a purity of 4.35 parts per million. For added flexibility a motor-driven compression distillation unit has been installed.

Piping Design Features . . . The main superheated steam header is a 40-ft long turned and bored forging, 18 in. O.D. by 3.58 in. thick, of 2¼% Cr-1% Mo, Spec. A-213, Grade T-22 material. One end of this header is connected to the final superheater outlet header by 18 5.25-in. O.D. by 1.15-in. thick seamless tubes of the same material. These 18 tubes are grouped together and with several reverse loops provide the necessary flexibility to take care of all expansions and the combined movements of the boiler and turbine. The other end of the main header is connected to the two turbine stop valves through a connecting cast Y fitting of similar material, Spec. A-217, Grade WC-9.

Turbine stop valves are of modified Type 316 stainless steel, each fitted with an inlet stub end of 2¼% Cr-1% Mo material for field welding to the Y fitting. The valve stub end necessitated a shop weld between the two materials having widely different thermal expansion characteristics. This weld was made of the simple butt-weld design and formed under carefully controlled conditions and with extensive inspection. To ascertain the service behavior of this weld, which is of considerable technical significance and some controversy, and to predict in advance its probable history, a test vessel is provided with an identical weld performed under similar conditions in all respects. This test vessel is connected in parallel with the main header and is exposed to the full superheater outlet steam temperature and pressure. It is suitably valved off so it may be cycled through the full pressure and temperature range, at will, to predetermine the effect of such repeated operations on the integrity of the weld.

Reheat Piping . . . High-temperature, 1,000 F, piping from the reheater to the intermediate-pressure turbine consists of two parallel leads 16 in. O.D. by 1.03-in. thick seamless alloy pipe. The material is 1¼% Cr-½% Mo, Spec. A-158, Grade P-11. This piping is designed for 450 psig pressure and the runs are laid out for adequate flexibility to accommodate its expansion in addition to the reheater and turbine terminal movements.

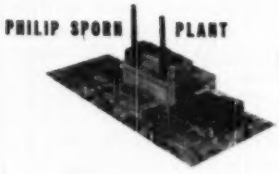
The high-pressure bleed steam piping designed for 170 psi and 800 F is of seamless alloy material ½% Cr-½% Mo, Spec. A-280. The decision to use this material was based entirely on its superior resistance to graphitization at the temperature level involved.

The two turbine stop valves serve also as the boiler stop valves. This arrangement has a substantial background of service experience and represents a most practical approach to the problem presented by proper valving between a single boiler unit and a turbine.

Evaporator Makeup and Sanitary Supply . . . Evaporator makeup and sanitary supply are prepared from raw Ohio River water by: (1) Clarification with ferric sulfate and soda ash, (2) filtration, (3) zeolite softening, (4) chlorination, and (5) dechlorination. The treating plant effluent capacity is 340 gpm (170,000 lb per hour) which is sufficient to meet the ultimate needs of the station.

Heating, Ventilating and Air-Conditioning . . . A total of 14 high-pressure propeller-type ventilating fans, ranging in size from 36 in. to 72 in., furnish ventilation air to different areas throughout the power house. Three 72-in. fans deliver air from a roof intake through a vertical shaft to ventilate the turbine room and the space below the main operating floor. This air can be filtered, if necessary. The other eleven fans, located along the exterior wall, supply ventilation to local areas. All of the ventilation air taken into the plant is exhausted through the fan floor level at the top of the boiler room to outdoors. Of this ventilation air, 300,000 cfm, in passing through the fan room, serves as supply for the forced draft fans of the boilers. The coal conveyor floor above the coal bunkers has a separate ventilation system consisting of two roof supply fans and two roof exhaust fans, each handling 17,500 cfm. The control rooms on the main operating floor are air-conditioned by means of a self-contained 10-hp mechanical refrigerating cooling unit and a heating coil supplied by steam from the power plant.

Control Of Units Centralized In Pairs For Effective Operation



Controls for each pair of units is centralized in a joint control room. Arrangements permit operators to support each other during emergencies. Unit operator handles both mechanical and electrical controls

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UNIFORMLY satisfactory experience in other plants of the American Gas and Electric System influenced the inclusion of a centralized control room in the layout of Philip Sporn Plant. Earlier control rooms clearly proved the feasibility of combining all electrical and mechanical operations at one point. At the new plant the problem was to use accumulated experience, plus advances in the art, to achieve a control center that would be both functionally sound and economically justified.

General requirements of a centralized control scheme that is to operate with minimum attention from plant personnel should provide that:

1. Routine matters be delegated to continuous automatic control.
2. Remote operation be provided for many functions, even though infrequently used. Certainly all items that will be operated during tripouts or loss of load.
3. Alarms, charts, and scales be arranged to notify the operator as soon as abnormal operating conditions arise.
4. Communication errors be reduced to a minimum.
5. Controls be arranged to make correct action easy and likely under stress.
6. Interlocks and trip controls be provided to prevent creation of misoperation or development of dangerous conditions.
7. Sufficient instrumentation be provided to permit normal meter maintenance without interrupting essential readings during operation.

Control Room Layout . . . The over-all arrangement of Philip Sporn Plant, with its unit concept and simplicity of operation lent itself well to centralized control. The initial commitment for two units simplified the over-all control layout, since each pair of units could share a control room situated between them.

The joint control room at Sporn Plant permits each operator to support the other during emergencies involving only one unit. Moreover, the assistant operator may be shared between units, effecting a definite saving in manpower.

Panels in the control room (Fig 14) were laid out as two symmetrical U-shapes having the open ends facing each other. This permits operators to cooperate in emergencies and have the assistant operator equally available to either unit. The same left to right sequence of controls and equipment was maintained on both panels to permit interchangeability of action and minimize errors in operation. A few instruments of secondary importance, that did not function as an operating guide but did furnish a useful record, were located on the back face of one side wing of the

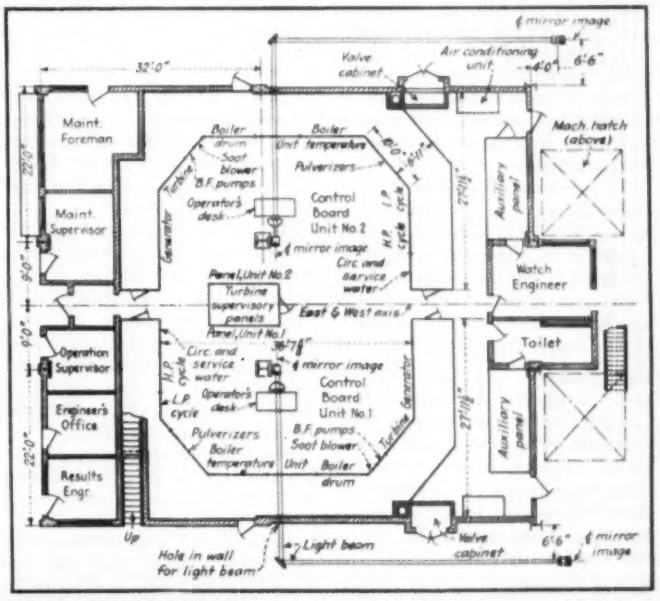
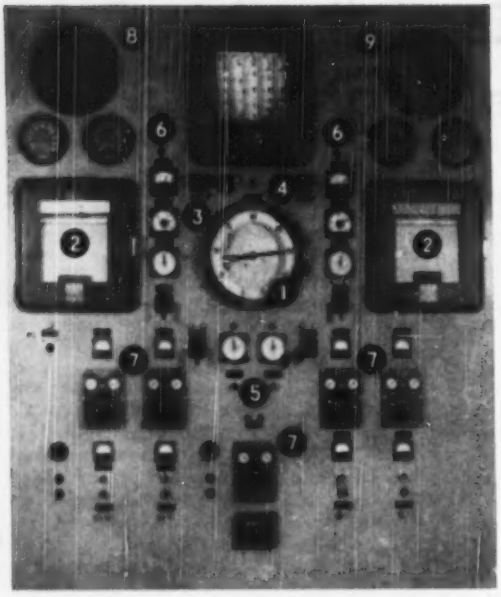


FIG. 14—CONTROL ROOM for first units has panels laid out as two symmetrical U-shapes



UNIT PANEL in center of each U mounts controls operator is most likely to have to operate simultaneously during a trip out or when coming up to load. These include: (1) generator load indicator-recorder; (2) initial and reheat temperature recorders; (3) boiler and turbine trip buttons; (4) resets for turbine overspeed, stop valve and low-vacuum trips; (5) test arrangement for stop valves; (6) speed and load indicators for each shaft of set; (7) fan controls; (8) boiler drum level indicator and (9) steam pressure gages

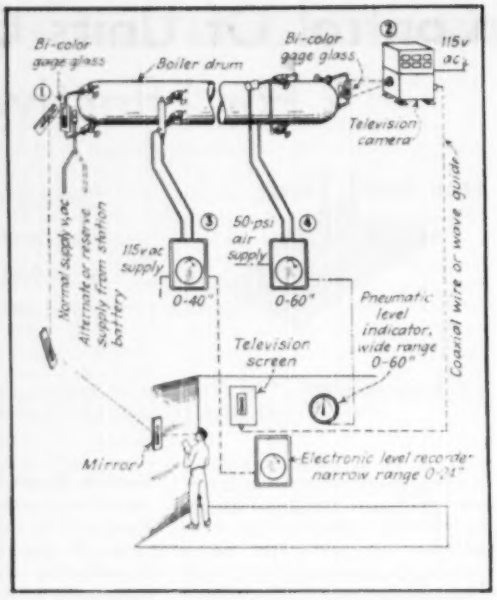


FIG 15—FOUR DRUM LEVEL INDICATIONS are brought into the control room (1) by conventional bi-color gage glass and mirror; (2) by wired television (3) by telemetering from level recorder and (4) by telemetering from a second drum level recorder having wider range. Even if ac power and control air are lost together, lighting of bi-colored glass will transfer to station battery restoring this indication; thus methods 1, 2 and 4 give visual indications that check throughout entire range of operating pressure over operating pressure range

panel. Placing them in the control room had these definite advantages: (1) Operators can change charts when they do those on the rest of the panel; (2) malfunctioning would be observed and corrected sooner, and, (3) clean environment would minimize maintenance.

To avoid leakage of high pressure steam and water lines inside the control room, all flow meter bodies were located in the plant and readings are telemetered into the control room. Long runs of tubing or piping are avoided as in the problem of maintaining proper slope for venting.

Unit Panels . . . In the center of each U-shape is a unit control panel (see picture) mounting only the most important of the controls and instruments. On this panel are located those controls that the operator is most likely to have to operate simultaneously during or following a trip-out or when coming up to load.

Boiler Controls . . . Air-operated combustion control using the air flow-steam flow relationship for the readjustment of combustion conditions has been provided. Air failure locks, reset from the panel, were developed especially for this installation. This avoids the necessity of an operator going to each of the nine drive units to reset them after an air failure. Electric position indicators give proof that motion was obtained.

Although the boiler is designed for ultimate operation without induced draft fans, furnace draft control was provided for conventional suction operation of the furnace. This control was applied to the induced-draft fan vanes since the forced-draft vanes were used ,for air flow control to avoid unnecessary changes when converting to pressure operation.

The boiler design provides for flue gas recirculation in order to extend the range of controlled superheat to lower ratings. For example, with 8% recirculation at 650 M lb/hr for steam there is about 100 F gain. For lower loads recirculation is increased to 17%. This also increases steam temperature at all ratings below that at which it is no longer possible to reach 1,050 F.

With flue gas recirculation it is mandatory to measure combustion air at some point outside the boiler gas passages since the mass flow there will no longer provide a constant index of the oxygen supply to the furnace. This measurement is made with two venturi-like sections in the air duct immediately below the air heaters. Differential from each is converted to flow and the two flows totalized before being recorded or being used in the combustion control.

Ultimate operation with pressure combustion calls for somewhat different interlocks from those provided in normal suction furnace designs. Since at any time it may become necessary or desirable to revert from pressure to suction operation, a pistol-grip switch has been provided on the unit panel to select the appropriate set of interlocks. On pressure operation the forced draft fans continue to run to provide scavenging air to the

furnace, to prevent back flow of hot gases and dust through secondary air ducts, as well as the loss of sealing air on rotating parts.

To minimize the popping of the spring-loaded safety valves on the boiler and superheater, a 3-in. motor-operated globe valve was placed at the turbine end of the main steam header and vented to atmosphere. This valve is normally under the control of a 1,500-2,500 psi pressure controller which has contacts set to open the valve somewhat before the first spring-loaded valve would pop.

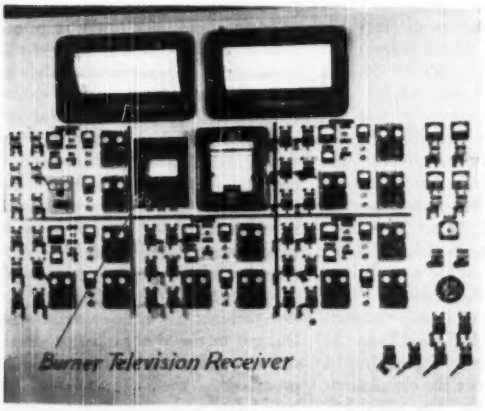
Four Drum Level Indications . . . Because the operator must at all times have a true indication of the boiler drum water level this vital indication has been brought to the control room by four means (see Fig 15). (1) By conventional bi-color gage glass and mirror system; (2) by wired television from the opposite end of the boiler drum; (3) by telemetering (electric) from a drum level recorder; and (4) by telemetering (pneumatic) from a second drum level recorder having a wider range, and which is also fully corrected for density changes. Note that simultaneous loss of ac power and control air are required to lose all normal indications.

The boiler has one spare pulverizer. It is intended for use only at extreme high loads or when wet coal interferes with normal pulverizer output. It was therefore anticipated that there would be considerable shifting of pulverizers in and out of service. To simplify this operation all controls associated with each pulverizer are arranged in a rectangular group. These groups have been centered around the receiver element of the burner television (see picture) so that when the operator shifts pulverizers he can see that ignition is established on the burners coming into use. This burner television set is the heart of the remote lighting-off equipment since it permits safe operation without the necessity of sending a man to the burner level.

Pulverizer Temperature Control . . . One control which has become common in the plants of the American Gas and Electric System since 1945 but not widely used elsewhere, is automatic control of the pulverizer outlet temperature. This is an electrically-operated control receiving its impulse from a mercury-filled bulb in the fuel-air stream. Without this control, variations in coal moisture and secondary air temperature could cause an operator to spend considerable time readjusting tempering air dampers on five pulverizers. Temperature indication is provided by a high speed recorder capable of covering all pulverizers in 20 sec.

Steam Temperature Control . . . Modern turbines do not permit the operator to alter the steam temperature radically. The divided construction of the main superheater, providing transposition in the gas stream of the second portion, tends to avoid any wide divergence in the steam temperature across the boiler (see Fig 16). Steam temperature is recorded at numerous points in the superheater and on its way to the turbine. Final superheater temperature for each half is recorded and this is checked by recording the throttle steam temperature as well.

Final temperature from each half of the reheater is separately recorded. Again, the temperature at the intermediate pressure turbine inlet is recorded as a check on the two reheater outlets. Since the steam from the halves of the reheater is carried directly to the upper and lower valve chests of the intermediate pressure turbine without mixing, the two temperatures must be substantially the same. A maximum differential of 100 F has been set. To present this difference to the operator constantly, the intermediate-pressure turbine inlet recorder reads alternately the temperature in leads to the upper and lower valve chest rather than their average. With the continuous curve drawing instrument this results in a rather unconventional chart record, (see Fig 17) but one that attracts immediate attention to a dangerous condition which would otherwise require reference to two charts and a careful



BURNER CONTROL PANEL has controls for five pulverizers arranged around receiver element of burner television. Controls for one pulverizer include: Switches for lighter, fan, pulverizer and feeder control; dampers for fuel output, tempering air and air supply, secondary air windbox dampers and burner shutoff dampers

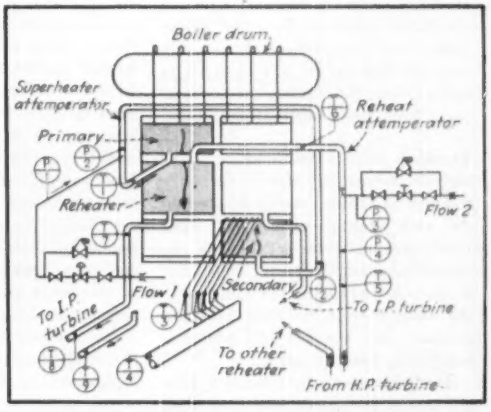


FIG 16—SCHEMATIC OF REHEATER AND SUPERHEATER showing transposition, points of temperature measurement, and control of attemperator water. Divided construction of main superheater tends to eliminate wide divergence in steam temperature across the boiler. Temperature is recorded at many points in superheater

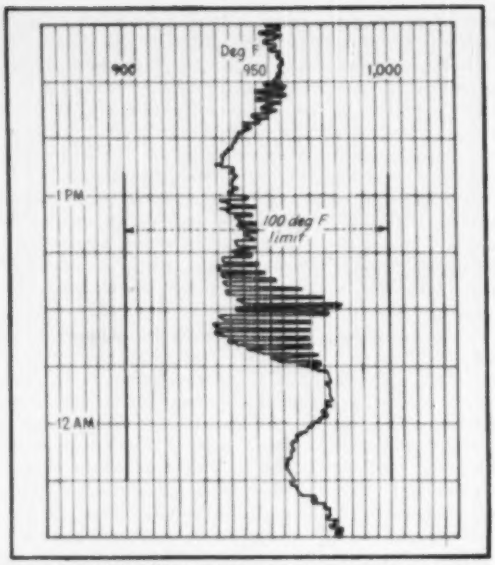


FIG 17—TEMPERATURE CHART of LP turbine inlet temperature shows temperature differential of steam entering upper and lower valve chests of intermediate pressure turbine from halves of the reheater. Maximum allowable differential is 100 F. Since magnitude and not sign of the differential is important, no effort is made to identify upper and lower leads of this temperature recorder

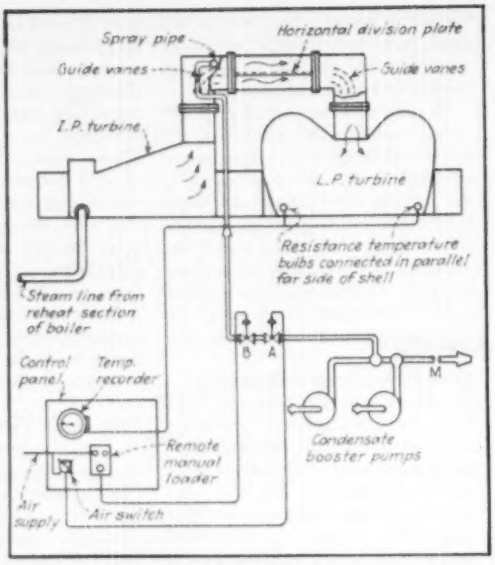


FIG 18—SPRAY DESUPERHEATER system in crossover to the double flow low-pressure turbine. Double valves in water supply line, air operated from control room, insure against water leakage to desuperheater during normal operation. The large crossover duct provides an adequate space in which to desuperheat the relatively small quantity of steam passing under no-load conditions

comparison of their readings.

Further backup for all steam temperatures is found in the 160-point superheater tube temperature recorder. This instrument was provided to give notice of individual tubes or groups of tubes that are exceeding their design temperatures. However, with 60 thermocouples on the outlet tubes of the main superheater, and 76 points on the reheater it is possible to use this recorder to approximate the final steam temperatures from these parts of the boiler.

Turbine and Condenser . . . The turbine is normally started from the starting handwheel switch located on the unit control panel, and after synchronizing load would also be controlled from this point. Provision is made for adjusting the shaft packing water flow to maintain optimum pressure and suitable exit temperatures from the shaft seals.

Temperature of the cooling hydrogen inside the generator is controlled by the quantity of condensate circulated through the hydrogen coolers. This flow is adjusted from the control room by means of two motor-operated globe valves in the cooling water system. Generator field hydrogen gas, and stator temperatures are recorded by strip chart instruments.

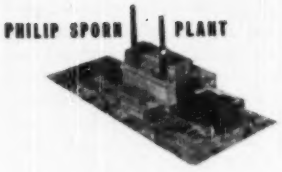
Control of Circulating Water . . . Flow of circulating water through the condenser may be reversed from the control room. Normally this would require operation of eight different valves and would present the hazard that the flow might be stopped in either or both halves of the condenser while the operator was attempting to make the change. To avoid this risk and to simplify the handling of condenser valves, appropriate inlet and outlet valves serving one half of the condenser have been controlled from one switch. Position indicating meters show any failure of the valves to follow through. This avoids the danger of losing vacuum.

To operate under conditions of extremely low water in the river a high speed winding on the circulating-water pump motors was provided. Pumps may be switched from high to low speed at the control room.

In the event the unit trips off the line, the control room operator has many things to do. Among adverse conditions will be the drop in vacuum due to low water flow through the condenser of the steam-jet air ejector. To overcome this a recirculating valve has been provided, that can be opened by an air switch on the panel permitting a flow of about 200,000 lb per hr through the steam-jet air pump condenser and back to the main condenser hotwell. This is sufficient for maintaining vacuum indefinitely without recourse to the main shell ejector.

Operation of the turbine at synchronous speed, but without load would result also in considerable heating of the exhaust hood, particularly if the condenser pressure should be greater than 2 or 3 in. Hg absolute. A spray desuperheater system was therefore provided in the crossover to the double-flow low-pressure turbine. To insure against water leakage to the desuperheater during normal operation, double valves are provided in the water supply line, both being air-operated from the control room (see Fig 18). The exhaust hood temperature is indicated by a large recorder immediately adjacent to the water control valves.

Simplicity Is the Keynote of Plant Electrical Features



All unnecessary features eliminated from electrical facilities. Equipment locations chosen to make leads short and direct. Switching held to a minimum to reduce operating errors

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ELECTRICAL FACILITIES at Philip Sporn Plant have been designed and constructed with simplicity as the keynote. Each generator and its associated equipment is a unit—a complete generating plant in itself. It is independent of other units in the plant. All connections are as direct as possible. Switching is kept to a minimum to reduce operating problems. The simplified one-line diagram best illustrates this.

The turbine room is located on the river side of the plant, with main step-up transformers immediately outside the building wall on a concrete platform along the river, making the leads from the generator to the transformers very short. They consist of two 7-in. aluminum channels per phase placed vertically side-by-side. Each phase is a straight-away screen-enclosed run from generator to transformer, broken only by the disconnecting switch provided for facilitating testing and maintenance.

Neutral leads of each generator are bussed solidly together, then connected to the insulated station ground bus through a single pole disconnecting switch. This bus is connected to ground by either one of two resistors, one being a spare for the other, to assure proper grounding protection to generators in operation at all times. Each resistor is rated 11 ohms, 8,000 v, 727 amp for two minutes, with a temperature rise of 500 C. The neutral resistors are cast iron grid type mounted on 23-kv insulators.

The 3-phase step-up transformers are bussed on the high-voltage side and a single 3-phase lead rises vertically to the roof of the station building, over which it passes to a steel tower line to the switchyard, about 2,500 ft away, where, by means of two breakers, it is connected to the two 132-kv buses. In the case of unit No. 1 a motor-operated air-break switch in the lead enables the break-

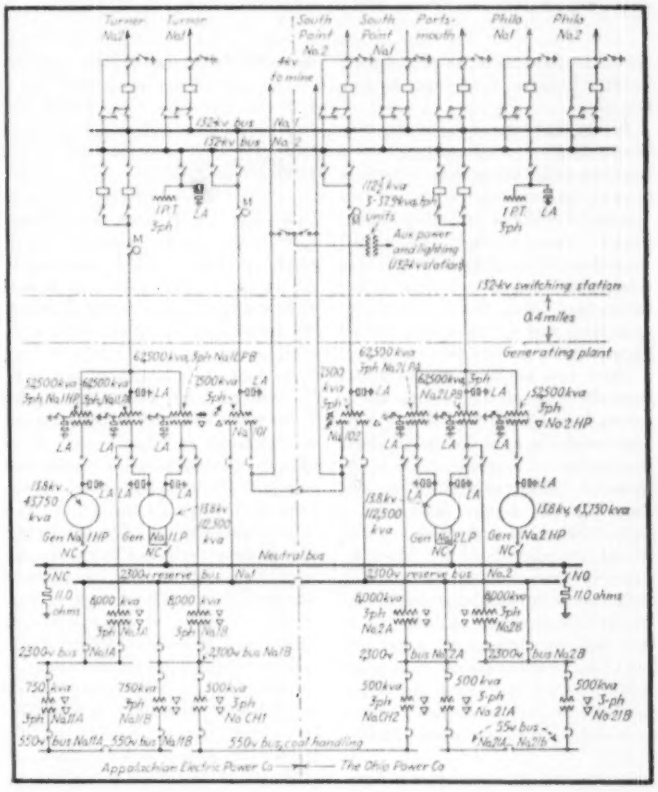
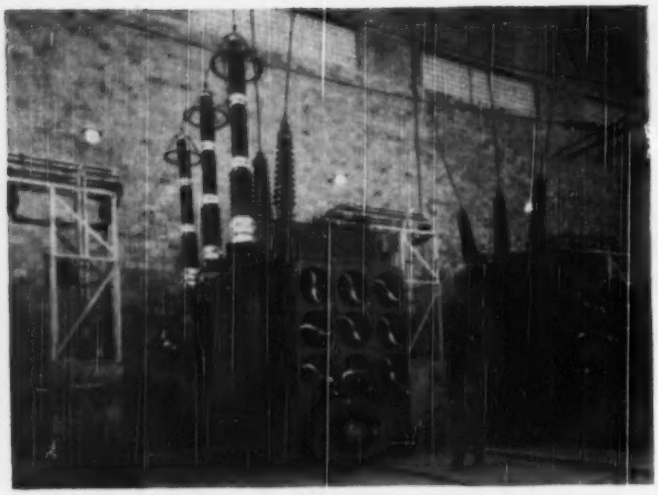


FIG 19—ELECTRICAL CONNECTIONS throughout Sporn Plant are as direct as possible. Switching is kept to a minimum. Each generator and its associated equipment is a unit



MAIN TRANSFORMERS for each unit are located immediately outside the turbine room wall, have short straight-away lead from generator. Two of the three main transformers for a unit are shown. These step up transformers are three-phase, bussed on the 132-kv side. One 52,500 kva unit is supplied from HP generator; two 62,500 kva units from the two winding LP generator. Each is connected delta on 13.8 kv side, wye on high-voltage side

ers to be used as a transfer circuit whether Unit No. 1 is in operation or not.

Returning to the leads of the double-winding low-pressure generator, a tap from each set connects through a disconnecting switch to one of two 3-phase, 8,000-kva auxiliary transformers, using a single 7-in. aluminum channel per phase. These transformers are located on a floor below the turbine room, not far from the generators and within easy reach of the switchgear centers they serve.

These two auxiliary transformers normally serve all the various motor drives, lighting and other loads associated with the generator unit. Each connects to a separate 2,300-v ungrounded delta-connected bus for major auxiliary motors. From each of these 2,300-v buses there is a transformer stepping down to 550-v to serve a sectionalized ungrounded delta bus for the smaller auxiliaries of the unit. In the case of Unit No. 1 these two transformers are rated 750 kva each, as they care for a number of services not duplicated with other generator units. In the other cases these transformers are rated 500 kva each.

Backing up the normal auxiliary supply are two 3-phase, 3-winding, 7,500-kva transformers which step down to 2,300 v and 4,000 v from the 132-kv bus. These are located physically in line with and between the Unit No. 1 step-up transformers and those for Unit No. 2. The 132-kv leads go over the top of the building from the switchyard to these transformers as do those for the main transformer banks. Normally there would be only one such transformer for the plant. Its purpose is to serve a unit auxiliary system during the starting up or shutting down of the unit, or if there is an emergency. It provides an outside source of power to the stations, a bus and in turn to the 2,300 v bus sections. At Sporn, however, there is an adjacent coal mine with an eventual demand of approximately 5,000 kw and it is most advantageous to serve the mine from the reserve auxiliary transformer. Doing this, however, requires that a second transformer be available to provide for flexible and adequate mine and station auxiliary service under all conditions. One 4-kv feeder from each transformer serves the mine.

Each reserve auxiliary transformer has a 2,300-v connection to a station bus which in turn connects to each 2,300-v bus section in the station.

The 132-kv yard has a double-bus system, operated normally with each generator connected to both buses and the seven outgoing feeders connected four to one and three to the other. Each feeder has a single oil circuit breaker with selector disconnecting switches to each bus and a bypass disconnecting switch, as well as the usual isolating disconnecting switches. All these disconnecting switches are manually operated. The reserve auxiliary transformers are connected one to each bus. Buses may be operated as a main and transfer bus to service line breakers, and either one alone may be used as a single bus system, if necessary.

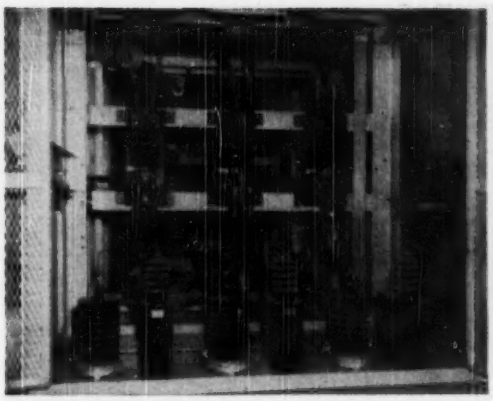
Generators . . . Both high and low pressure generators are hydrogen cooled. The high pressure generator is a 3,600-rpm machine, rated 35,000 kw at 0.8 power factor and 0.5 lb hydrogen pressure. By increasing the pressure to 25 lb, the rating is 42,700 kw at 0.8 power factor. The low pressure machine, rated 1,800 rpm, has a 0.5 lb hydrogen pressure rating of 90,000 kw at 0.8 power factor, and an increase to 25 lb hydrogen pressure brings this up to 109,800 kw at 0.8 power factor. Both machines have a short circuit ratio of 0.9 at 0.5 lb hydrogen pressure and are connected wye for 13,800 v.

Hydrogen equipment, including seal oil tanks, pumps, valves and hydrogen tanks, is located directly below each generator, with supervision at the turbine room floor level in a cabinet containing temperature, pressure and purity indicators.

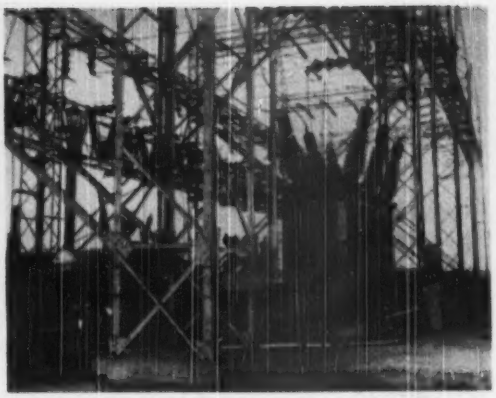
Usual vacuum treatment for the high pressure generator seal oil is eliminated in favor of a simple continuous scavenging system maintaining gas purity without pumps. Low pressure generators have vacuum treatment equipment which can be shut down in favor of continuous scavenging as desired.

Excitation System . . . Each generator has a 250-v shaft-end exciter for normal independent excitation. These, rated 145 kw and 350 kw for the high and low pressure generators, respectively, are completely enclosed and cooled with filtered room air.

There are, however, two station exciter buses to which the fields of any of the generators may be connected. Each bus has a motor-driven 350-kw exciter capable of handling a complete generator unit. Normally one



IMPULSE PROTECTION FOR GENERATORS comprises 12-kv arresters and 13.8-kv capacitors. Devices connected to generator leads are insulated for 23 kv as added precaution against breakdown



CIRCUIT BREAKERS in the 132-kv switchyard are provided with facilities for draining dirty oil and refilling with clean oil from two 10,000-gal tanks. Breakers are rated at 5,000,000 kva

motor-driven exciter and its bus will be used to furnish excitation for the fields of the compound generators while they are being brought up to speed so as to keep them in synchronism. The other motor driven exciter and its bus can be used for this purpose for another machine simultaneously or furnish emergency excitation to a machine whose exciter is out of order. Complete switching flexibility is available for these functions. After a machine is up to speed, its direct-connected exciter will take over the load.

Each generator has a static voltage regulator which controls a motor driven amplidyne generator. By boosting or bucking the main exciter field the amplidyne provides proper excitation for the generator at any given moment. Two single-phase potential transformers on the generator leads activate the static regulator through compensation to control the voltage regulation on the 132-kv bus.

Transformers . . . Main step-up transformers embody all the important advances of recent years and are therefore smaller and lighter than previous designs. They are forced air, forced-oil cooled; they utilize high permeability core iron; and they reflect the greatest possible economy in the use of material, as the following table demonstrates:

Size, Kva	52,500	62,500
Weight, Lb	152,700	156,800
Floor Space, In	129 x 191	133 x 191
Height over Tank, In.	182	182
Height over Arresters, In	302	302

This results in units which require only a small amount of field assembly involving bushings, coolers and control cabinets.

Two of the three units are rated 62,500 kva each and serve the two windings of the low-pressure generator. The third unit, rated 52,500 kva, is for the high-pressure unit. Each is connected delta on the 13,800-v side and wye at 132,000 v.

In accordance with practice of fifteen years past, the 132-kv winding has 115-kv class insulation. Bushings are 115-kv design with 132-kv ungapped outside porcelains, to take care of possible contamination conditions which might conceivably result in flashover. Graded insulation is used on the 132-kv windings while the grounded end of the winding is insulated for 46 kv and has a 46-kv ungapped bushing.

All three transformer high voltage windings are protected with one set of 109-kv arresters mounted on the tank of the middle transformer and 50-kv arresters on each transformer tank protect the neutral ends of the windings. On the low-voltage side of the transformer 25-kv ungapped bushings are provided.

Each transformer has an inert gas cushion to protect the oil and the cover is welded to the tank to eliminate gasket difficulties. Each unit has the air-to-oil, fin type tubular cooling units divided into three banks. Each cooler bank is equipped with a 220-v motor driven, oil immersed pump and six single-phase, 220-v fans.

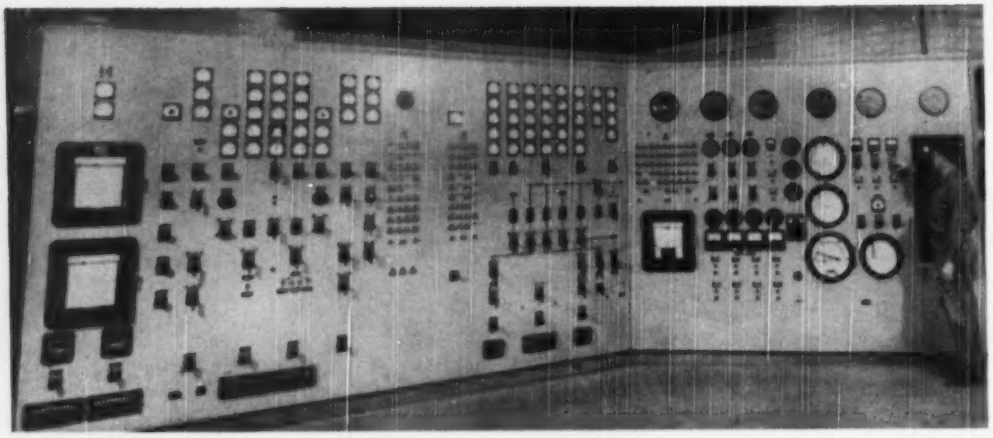
Power for transformer auxiliaries is integral with the unit, there being two 2,300-v single-phase transformers installed inside the main tank. One of these alone can carry the entire fan and pump load.

Flexibility of operation of coolers is obtained by the use of valves. Transformer capacity is reduced to 80% with the loss of one cooler and to 50% with the loss of two coolers.

The 132-kv winding has five tap voltages, available through a manually operated tap changer. Bushing type current transformers are provided for relay protection. A type TRC thermal protective relay gives an alarm in case of overheating. The transformers are protected by an automatic carbon-dioxide fire smothering system.

The 3-phase, 8,000-kva, 13,800/2,300-v auxiliary transformers connected to the windings of the low-pressure generator are forced air cooled, Askerel-filled. The cost of using two such transformers per unit instead of one is more than compensated for by the savings resulting from the lower cost of the auxiliary switchgear possible. Use of two units also eliminates load unbalance between the two windings of the generator and contributes to diversity of risk.

The 7,500-kva 3-phase reserve auxiliary transformers stepping down from 132 kv are similar in every respect to units normally supplied for distribution purposes in a high voltage system. The low tension winding



PANELS in centralized control room contain all electrical and mechanical controls for one entire unit. Shown above, left to right, are controls for generator, auxiliaries and turbines. Back of the board is enclosed in order to keep out dirt and so reduce maintenance

is divided into two sections, one being connected for 2,300 volts to serve the station reserve auxiliary bus, and the other being connected for 4,000 volts to serve the coal mine.

The 750-kva and 500-kva station auxiliary transformers stepping down from 2,300 to 550 v are located indoors and are 3-phase units, self-cooled and Askerel insulated. They are located as close as possible to the switching section which they serve.

The 500-kva, 3-phase units which step down from 2,300 v to the 550-v coal handling bus are located outdoors. They are oil insulated and self-cooled, of conventional design.

Switchyard . . . The 132-kv switchyard is operated independently of the main plant. It is entirely automatic and has complete facilities similar to any other isolated switching station. A control building not only houses the control panels, battery, oil handling and heating facilities, but has provision for a system operating force.

The two 132-kv buses and cross buses are supported by overhead steel structures using strain buses with 1,000,000 and 750,000 cir mil copper conductor, depending on loading. Connections from buses to equipment are aluminum tubing. Columns are extended above the top trusses to support the ground wires from the incoming lines and so provide lightning protection.

All 132-kv breakers are oil insulated, dead tank type, rated 5,000,000-kva interrupting capacity. Tripping time is three cycles. All feeder breakers are arranged for 20 cycles or less reclosing from the time the trip coil is energized. Each breaker is equipped with six standard bushing type current transformers for relay protection and bushings have capacitance taps for obtaining potential. Pneumatic mechanisms are used.

In addition there are three orthomagnetic bushing-type current transformers in each line breaker for metering the output of the plant to The Ohio Power Co and Appalachian Electric Power Co. These take the place of conventional 132-kv current transformers and give a high degree of accuracy, along with substantial economy in first cost.

For relaying and metering a three-phase potential transformer is connected to each 132-kv bus. Using 115-kv class insulation and 115-kv bushings with 132-kv outer porcelains, these are protected with 109-kv arresters.

Auxiliary System . . . The auxiliary drives, totaling 16,000 connected horsepower for each generator unit, are entirely electrical. The major portion of this load is in ten motors ranging from 450 to 2,000 hp, each connected to individual breakers on the 2,300-v bus. Drives of like function are as evenly divided as possible between the two bus sections. Sixteen motors, ranging from 150 to 400 hp, are served from these same 2,300-v buses in groups. Each group has a single breaker with individual motors served by 2,300-v fused contactors. Economic studies indicated that appreciable savings could be made by using 2,300-v instead of 550-v motors and switching them in groups with contactors. This reduces transformer capacity and copper. The 550-v load is relatively small and comprises one hundred thirty-five smaller motors, rated ¼ to 125 hp. The larger and more important of these have individual breakers. Many, however, are grouped so that one breaker controls several through a service center where there is a combination magnetic switch and circuit breaker or manual starting device for each drive. Where motors are grouped on a single breaker, the grouping is such that operation of the plant is not disturbed by its removal from service.

Battery and Control System . . . The 250-v battery control system is of decidedly major importance in the design and operation of a power station. Three batteries are required for the Philip Sporn installation.

In the plant a 610 amp-hr, 120-cell battery normally takes care of valves, small direct-current drives and other requirements where there is a need for a substantial amount of power for a relatively long period. A second 120-cell battery, rated 280 amp-hr is at the opposite end of the plant to

energize the 250-v control buses and circuits. The separation of the two batteries provides against an accident involving both to assure continuity of control.

Three motor-generator sets charge these batteries. Normally a 10-kw unit floats on each. A 30-kw motor-generato. set provides periodic overcharge. Each charging equipment can be used at will on either battery. Either battery can serve all control functions.

In the 132-kv switchyard an independent 240-amp-hr, 120-cell battery is normally charged by floating a 5-kw motor-generator set across it. A second 5-kw set is provided so that with the two in parallel the battery can be given an overcharge.

Relays and Control Equipment . . . Differential relays, operating in one to two cycles and immune to bushing current transformer saturation effects, protect the 132-kv buses. These are arranged to be effective regardless of type of switching set-up employed. The 132-kv outgoing circuits have one-cycle carrier current relaying in addition to mho type impedance relays for phase protection and inverse time and instantaneous relays for ground protection.

Each main generator transformer has percentage unbalance differential relay protection and a high speed inverse time ground relay. Product unbalance differential relays protect the generators while an independent differential relay system encompasses the entire transformer and generator unit, using percentage unbalance relays. Auxiliary transformer and connected leads have percentage unbalance differential relays.

Electronic relays synchronize the generator and feeder breakers. After the generator has reached approximately synchronous speed, all final steps of synchronizing are taken by the automatic speed matching and synchronizing relays, independently of the operator.

An automatic oscillograph records system disturbances to aid in studies of cause and determination of remedies.

The control room on the main operating floor contains all steam and electric control panels for operation of two units. The main board, horseshoe shape in plan, uses vertical panels. Generator and turbine controls are at the left, boiler controls in the center, and condensate controls at the right. Instruments and relays are flush-mounted. Mimic buses simplify operation. Vertical panels back of the generator control section accommodate relays and test equipment. Multi-colored panel wiring facilitates circuit checking.

Switchyard feeder control is independent of the plant and on back-to-back vertical panel boards in the switchyard control building. Individual unit and total plant output load recorders and automatic load frequency control devices for each generator are located on a vertical board in the switchyard control building for the system operators.

Control cables are located in open troughs below the switchboard and throughout the plant. Individual conduit construction is used only in short isolated lengths at equipment locations. Control cables in the switchyard are in a trench from which individual cables are buried directly in the ground, with short lengths of conduit for mechanical protection where the cable leaves the ground for the equipment. Indoor cable consists of separate conductors, each insulated with a synthetic compound, covered with a layer of asbestos which, in turn, has a coded colored cotton braid. Over the bundled conductors there is a hard finished fire-proof asbestos braid. Outdoor cable differs in that individual conductors are covered solely with a coded colored synthetic insulation, and the bundled conductors have a tough synthetic belt for mechanical protection.

Communication Facilities . . . Communication facilities permit all plant personnel wherever located to keep in constant touch with each other for the transmittal and acknowledgement of information, both under ordinary and emergency conditions. Twelve direct telephone lines, one unlisted, from selected locations within the plant substation and yard provide for communication to the outside. One of these circuits is for long distance calls. An automatic telephone exchange serves independently for internal communication. This is supplemented by a code call system. This code call system, initiated from any of the automatic phones, permits up to 45 combinations for calling key personnel. Coal handling facilities have their own sound powered, selective ringing phones.

Carrier current telephone facilities provide communication over the 132 kv circuits to The Ohio Power Company and Appalachian Electric Power Company.

Public address systems for each unit provide facilities at all critical locations for issuing instructions in connection with plant operation.

Lighting . . . Lighting is supplied through one transformer for each generator unit section, with an emergency transformer that may be connected to either one of two different auxiliary buses. In case of failure of a normal source important circuits are switched to the emergency source, and if all ac lighting power sources fail, a portion of the lighting is switched automatically to the larger control battery.

The control room has a specially designed but economical lighting system for glareless illumination of the boards. Specular effects and high brightness contrasts are avoided. This system utilizes parabolic aluminum low brightness troffers with two 40-w fluorescent lamps for the boards and low brightness parabolics each with one 40-w, T-17 lamp to furnish general lighting.

Oil Handling . . . Oil handling facilities are a minimum. Isolation of the 132-kv station from the main plant necessitates two oil handling systems.

The generating station has four 5,000-gal indoor tanks; two for dirty and two for clean oil. Tanks are manifolded and piped to the vicinity of the transformers where temporary connections may be made to individual units by flexible hose. A 100-gpm pump at the storage tanks will handle all oil transfers required. A portable filter press will be used when required.

At the 132-kv switchyard there are two 10,000-gal tanks. The dirty oil tank is divided into two sections by a central partition. These outdoor tanks are manifolded in the oil room of the control house, where there is a 100-gpm pump. Clean and dirty oil piping extends from the oil room to two headers located along the long axis of the station.

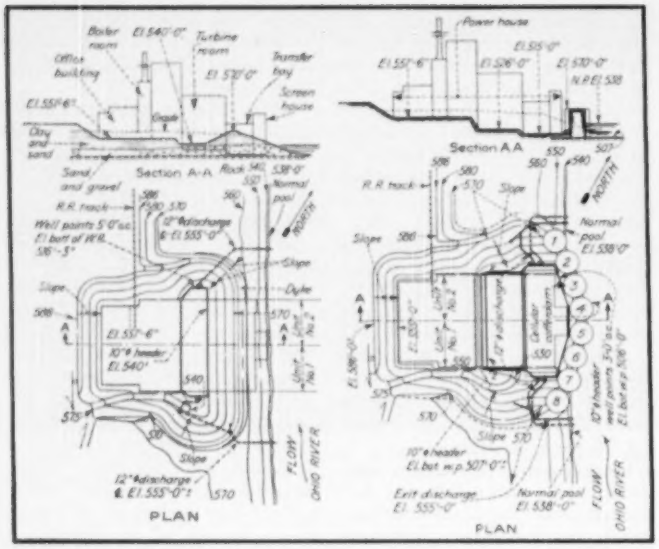


FIG 20—FIRST STAGE of foundation work was started in an open excavation surrounded by an earth dike. Three arms of the dike were to be permanent; the river arm to be temporary. Plant foundations used spread footings and slabs atop sand and gravel stratum. For dewatering, well points were driven on 3-ft centers and connected by 10-in. header connected to discharge pump. **SECOND STAGE** of excavation required driving eight interconnected steel sheet pile cells 51½ ft in diam and 63 ft high for riverward arm of cofferdam. These were driven to rock and filled with sand and gravel. Well points for second stage of dewatering system were installed as shown and excavation continued on east half of turbine room

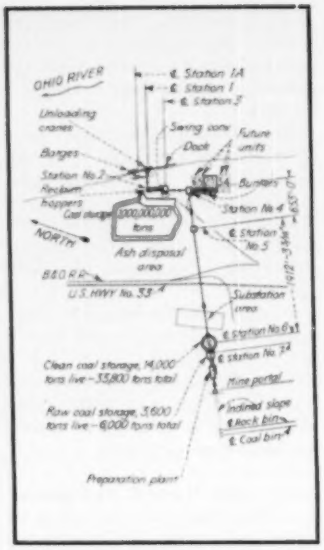
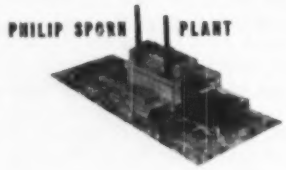


FIG 21—COAL HANDLING FACILITIES use conveyors to transport fuel from adjacent mine or coal dock to plant or storage yard. Initial mine installation can produce 600,000 tons of washed coal per year—can be expanded to 2,400,000 tons, full burn of ultimate six-unit plant of 900,000 kw. Dock facilities can handle 1,000,000 tons per yr.

Plant Construction and Architecture Keyed to Economy



Foundation design and construction coordinated for minimum cost. Plant cubage held to 23.3 cu ft per kw over-all. Conveyor systems link plant with nearby mine and dock facilities. Fuel storage capacity is 1,000,000 tons

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SITE of the Philip Sporn Plant is a typical Ohio River flood plain with rock at a depth of about 55 ft. Overlying the rock is a stratum of fairly dense sand and gravel 15 ft to 30 ft thick which is covered in turn by strata of silts and clays that extend to the surface. A general profile of the soil mantle at the plant site is shown in Fig 20.

Early borings showed that the sand and gravel lay several feet above the bottom of the lowest foundation slabs and that the power plant and most other structures could be supported on this stratum. This reduced the cost of the foundations considerably from what it would have been if the foundations had been carried down all the way to rock.

Cofferdamming . . . A study of river stage elevations over a period of some 30 years showed that the Ohio could be expected to overflow the plant site at least once a year. Consequently about 450,000 cu yd of earth were moved in order to raise certain areas above flood level for the contractor's plant, parking lots, storage areas and the railroad siding connecting with the B&ORR.

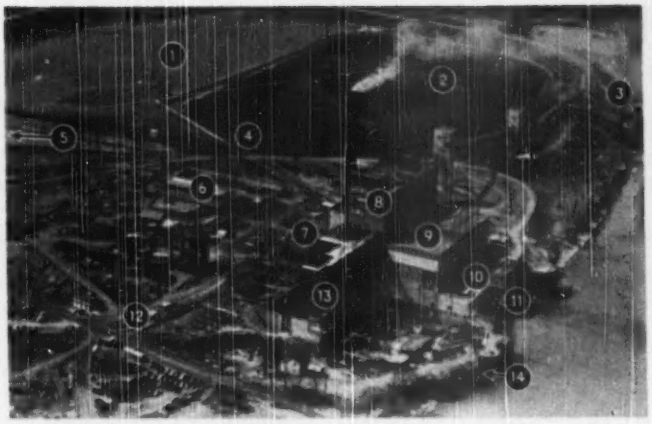
When construction was first projected the plan was to build an earth dike around the working area. How-

ever, such a dike would have extended a considerable distance riverward of the normal bank. The U. S. Engineer Office felt that construction for the riverward arm would interfere with navigation unless the dike and power plant were moved landward several hundred feet. A long flume would have been required between the screen house and the river. However, if steel sheet pile cells were used for it, it would be unnecessary to move the power house. When cost of the flume was compared with the use of the sheet steel pile cells it was apparent that the best thing to do would be to install a cofferdam, three arms of which would be an earth dam with a riverward arm made of interconnected steel sheet pile cells. Incidentally the cells are among the largest constructed to date.

The first section of the foundation work was started in an open excavation surrounded by an earth dike. Three arms of it were to be permanent; the riverward arm, temporary. Wellpoints were driven as shown by the first stage operations in Fig 20 and the working area satisfactorily dewatered.

Dewatering . . . The construction of the first section of the substructure foundations (inside the earth dike) and the driving of the cellular steel cells for the riverward arm of the cofferdam were done simultaneously. Eight steel sheet pile cells 53 ft, 6 in. in diameter and 63 ft high, all interconnected, were driven to rock and filled with sand and gravel. As soon as the cells were driven and after the wellpoints for the second stage of the dewatering operations had been installed, as shown in Fig 20, excavation was continued in the east half of the turbine room and screen house areas. Pumping with the second stage wellpoint system lowered the groundwater below the screens of the first stage wellpoints and it was shut down.

The performance of the wellpoint system during its first few months of operation conclusively demonstrated that it was capable of keeping the working areas dewatered under all design specifications. It was therefore decided not to drive the sheet piling for cut off to rock ground water flow under the earth dike arms of the cofferdam.



GENERAL SITE for Philip Sporn Station. Indicated are: (1) ash disposal area, (2) coal storage, (3) coal dock, (4) conveyor from mine, (5) 132 kv switchyard, (6) future parking area; (7), (8), (9), (10) and (11) are office, boiler room, turbine room, main transformers and gate house; (12), (13) and (14) are railroad spur, units 3 and 4 and the cellular cofferdam

After the concrete substructure and walls were constructed to elevation 596 ft, 6 in.—which is several feet above the highest flood of record—cells No. 3, 4, 5, and 6 and the short wing walls at the upstream and downstream ends were pulled and stored for reuse until the construction of the upstream extension to the power plant for Units 3 and 4 was started. Cells 1 and 2 were left in place permanently to serve as part of the cofferdams which will have to be built when the power plant is extended for additional units to the north.

Power House Structure . . . While every consideration was given to providing adequate space in the plant for assembling and servicing the equipment and while it was necessary to provide approximately 4 cu ft per kw for an unusually deep condenser pit, it was still possible to hold the volume of the plant to 23.3 cu ft per kw without including office and other service space, 26 cu ft per kw over-all.

Details of Concrete Work . . . About two-thirds of all the concrete placed for the complete project was employed in the construction of the power house substructure. The average concrete mix required about 4½ sacks of cement per cubic yard of concrete cast and developed a strength of 3,500 psi in 28 days.

Appropriate Specifications of the AISC, and the ACI and others were used for the design of the power house and appurtenant structures. The live loads were provided for as follows:

Turbine Room Main Floor Slab	350 lb per sq ft
Boiler Room Main Floor Slab	250 " " " "
Fan Floor	150 " " " "
Platforms	85 " " " "
Storage Area Floor Slabs	250 " " " "
Office Section Floor Slabs	50 " " " "
Roof Slabs	40 " " " "

Turbine foundations were proportioned in accordance with accepted design principles based mainly on limiting the deflection of important load carrying beams and columns. Other foundations supporting rotating machinery, as well as members supporting these foundations, were designed with due allowance for dynamic forces imposed by unbalance of the rotating equipment.

Stack Design . . . It will be noted from Fig 9, p 91, that the stacks are unusually high, rather slender and founded on the roof of the bunker bay. Estimates of the relative costs of supporting high stacks versus a ground supported stack show definite savings in favor of the former. Aerodynamic forces were allowed for in the stack design and their supporting structures, based on wind tunnel tests made at a local university. Final empirical design specification limited the stack deflection to 4 in. in any direction from the center line or a total

movement of the stack of 8 in.

The superstructure of the power house comprises a structural steel frame with a composite exterior masonry wall. Use of sash was held to a minimum. Glass block was employed instead for admitting natural light to the various sections of the plant.

Instead of conventional wood-formed concrete floor slabs or steel gratings, steel decking with a thin concrete covering was used throughout the power house and appurtenant structures at a very appreciable saving in cost. The use of decking speeded construction especially in areas where the erection of equipment and the construction of the building structure were carried on almost simultaneously.

Plant facilities were arranged to keep cleaning costs at a minimum. The building section that housed the coal conveyors feeding the bunkers was sealed off and separately ventilated. The slots through which coal is dumped into the bunkers were sealed by a continuous belt which also sealed the belt tripper. Steel grating which permits flyash and dirt to fall from one level to another was eliminated except where required for proper functioning of the ventilating system.

Coal Mine and Fuel Handling . . . Site for the Philip Sporn plant was selected to assure an economical and reliable supply of fuel throughout its service life. Coal reserves approximating 90,000,000 recoverable tons were purchased along with the plant site. These reserves form a solid block of coal under and surrounding the site on both sides of the river within a radius of four miles.

The coal measures lie about 150 ft below the flood plain. A fully mechanized mine to recover these reserves is now under construction. Mine coal will be transported up a slope by belt conveyor from the mine bottom to a washing plant 4,000 ft west of the power plant as shown in Fig 21. Washed, crushed coal is conveyed by a belt to a surge pile that is formed around a vertical pipe 72 in. diameter and 110 ft high. Openings throughout the length of the pipe permit coal in the surge pile to fall back into the pipe and feed a second 3,500-ft belt conveyor that transports the washed, coal to Station No. 4 where it can be directed either to the plant bunkers or yard storage. Besides permitting the mine and cleaning plant to operate when the power plant is not taking coal, the surge pile provides a source of plant fuel over week-ends and during times when high water would top the earth dike around the coal storage area.

The initial mine installation is being developed for a production of 600,000 tons of washed coal per year. However, surface facilities are being arranged so that, as more underground facilities are provided, they can be expanded to handle the full burn of the ultimate six unit plant, ie, 2,400,000 tons of clean coal per year.

Dock Facilities . . . Fuel supply not produced by the company owned mine will be delivered by barge to a coal dock built at the north end of the property as shown in Fig 21. The dock has facilities for handling 1,000,000 tons per year.

Coal from barges is transported by belt to either the stacking conveyor in the storage area or directly to plant bunkers. Isolated duplicate belts are provided between the station No. 4 (see Fig 21) and the bunkers in the power house. This insures a supply of coal to at least part of the ultimate plant in the event of a serious conveyor fire or major failure of the equipment for transporting coal to the bunkers from station No. 4 where conveyors from the mine, yard storage, and the river dock terminate.

Transportation of coal, either from the stacking conveyor to storage, or from storage to the reclaiming hopper, is done by four 30-ton tractor scraper units similar to those employed on major earth moving operations. Ten such units will be required for the ultimate plant to handle about 43,000 tons per week.

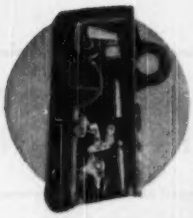
World's Largest Pile? . . . Sufficient area has been provided for the storage of what may well be one of the largest coal piles in the world, 1,000,000 tons. Because of the strategic location of the Philip Sporn Plant with respect to other AG&E Co plants on the Ohio River the quantity of coal held in storage has been increased above that needed for 100 days' operation of the ultimate plant. This storage pile will act as an additional reserve for some of the other river plants where storage capacity is not enough for 100 days' burn.

The flood plain on which the coal is stored is at an elevation which ordinarily would be flooded at least once each year. In order to prevent considerable quantities of coal from being washed into the river during such times and to permit operation of the power plant on relatively dry coal, the entire coal storage area is surrounded by an earth dike 44 feet high.

Ash Disposal . . . Ash from the collectors on the roof, hoppers at various locations around each boiler, and from the ash pit of each boiler is transported by air and water to a pit from where it is pumped as a slurry to a storage area shown in Fig 21 west of the coal pile. The ash makes a load bearing filll which will satisfactorily carry about the same foundation loads as most alluvial soils, ie, about 1½ tons per sq ft with tolerable settlement.

Fire Protection . . . The inherent risks to an interconnected system, even one as large as the Central System of the AG&E Co from fires and electrical failures were recognized in the design of this plant which ultimately will accommodate six large generating units having a net capability to feeders of 900,000 kw. Complete isolation for each pair of units was provided for and the walls, at the upstream and downstream ends of the initial two unit installation, were made permanent and provided with only such openings as could be readily closed off during a fire. The wall openings for the turbine room crane will be sealed by a curtain of water released by nozzles in the roof and directed in line with one face of the opening.

Selected areas and equipment are arranged for flooding with carbon dioxide gas in the event of fire. All electric cable, piping systems and equipment are so located and routed that if a fire or electrical failure occurs, only one-half of the generating equipment in any one section of the plant would be affected, ie, 137,500 kw of capacity.

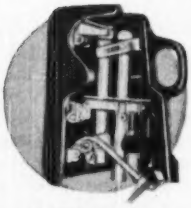


INDICATING

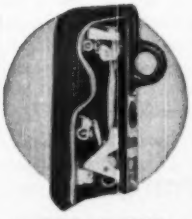
ONLY G-E OFFERS YOU··

Four Cutouts in one!

DROP-OUT



RECLOSING



DISCONNECT

And that's only half the story! By stocking only three interchangeable doors which fit both 5.2 and 7.8 kv, 50-ampere housings, you get the 4 operating functions illustrated at left—a total of eight essential cutout combinations! Available also in 100-ampere ratings, this unique flexibility reduces inventory and simplifies stocks.

INDICATING OR DROPOUT WITH A TWIST OF THE WRIST!

A small wire yoke, easily inserted or removed, determines whether the fuse-holder door "kicks out" at the bottom for visual indication, or drops open—either way giving positive evidence of a blown fuse.

RECLOSING DOOR AVOIDS UNNECESSARY SERVICE TRIP!

The two-element reclosing door restores service within one second after a temporary fault blows the first fuse link. By avoiding an extra service trip, it pays for itself the first time it operates!

FLEXIBLE DISCONNECT BLADE CAN'T GET LOST!

It's fastened to the door—can't be misplaced. This disconnect blade doubles the continuous current rating of the cutout. When the blade is disconnected and the door closed, the flexible cable extends downward to indicate that the circuit is open.

For complete information contact your G-E sales representative, or write for bulletin GEA-3448. Apparatus Dept., General Electric Co., Schenectady 5, N. Y.

GENERAL ELECTRIC

HOW TO DESIGN • CONSTRUCT OPERATE • MAINTAIN

SPLICING TRAILER, made from standard cabin trailer, provides trap door for working over manhole. Trailer houses manhole blower, fireproof corner, material bins and work bench

HOT OIL is kept at desired temperature by thermostatically controlled electric boiler

Well-Equipped Trailer for Cable Splicing

R. A. HORENBURGER
Philadelphia Electric Co
Philadelphia

STANDARD CABIN TRAILERS were utilized by Philadelphia Electric Co to solve the problems presented by the splicing of 13 miles of 69-kv oil-filled cable. After conversion, the trailers met such requirements as the necessity of a continuous supply of temperature-controlled hot oil; complete weather protection for splicing material and operations; mobility to meet a three-shift, five-day-week schedule; and facilities in which to store the tools and clothing of three shifts of splicers.

After stripping the trailers of their original furnishings, the company made the following changes and additions:

(1) The chassis was reinforced and a 3-ft-sq trap door installed in the floor; (2) additional wiring was installed; (3) metal clothes lockers, material bins and a work bench were added; (4) a corner was fireproofed to permit safe use of a plumbers torch and; (5) an electrically heated, thermostatically controlled double boiler was installed. A 5-kva trailer-mounted engine-generator set was provided for each trailer to supply light, heat and power requirements.

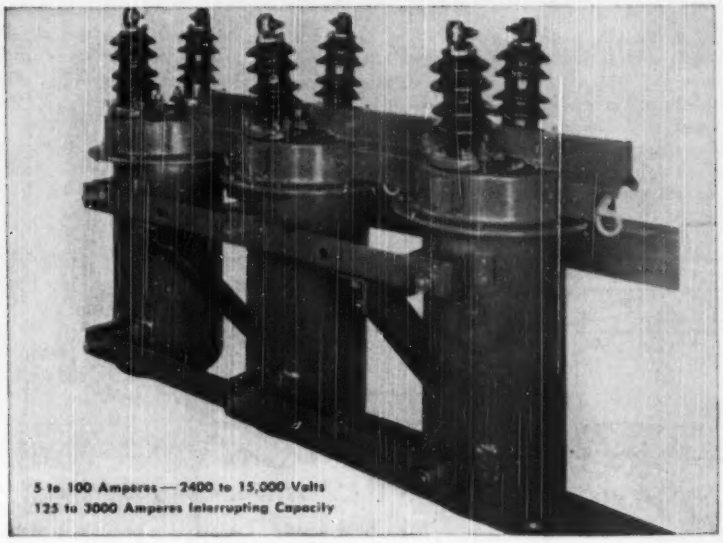
In use, the trailer was parked with its trapdoor over the manhole lid. A ring plastered into the manhole frame and a dust canvas hung from the bottom of the trailer around the manhole ring provided weatherproof splicing conditions. In seven years of experience with the trailers, the only change has been a telescoping service pole to feed the trailers by a service loop from the company's aerial facilities, instead of running the engine-generators. The trailers have also been used as field offices in lieu of shanties, saving the cost of buying or building shanties. Cost of moving the trailers was also appreciably less than would have been the cost of moving a construction shanty.

Water Sprays Reduce Stoker Grate Burning

WATER SPRAYS have been installed to cool stoker grates and reduce stoker grate maintenance at the Neosho Plant of Kansas Gas & Electric Co. While accurate data or long time averages are not available, it is now evident that stoker maintenance costs will be greatly reduced. Formerly, stokers required scheduled outages each four weeks to replace burned parts; now boilers are operated continuously for six to eight weeks, being limited by superheater fouling. Very few or no replacements are required due to burning. Practically all emer-

new TYPE FR-3

THREE-PHASE AUTOMATIC RECLOSER



General Electric's new FR-3 three-phase relayed automatic recloser extends the many advantages of the G-E Type FR-1 single-phase recloser to three-phase operation for rural distribution systems.

SIMPLER—Three FR-1 single-phase reclosers of the design that has been time-proven in service have been combined as a single unit designated Type FR-3. Thus : : :

INTERCHANGEABLE PARTS greatly reduce maintenance costs. As the FR-3 is essentially three FR-1 single-phase units, it's necessary to carry in stock parts for only *one* type of recloser.

COMMON LINKAGE ties together the lock-out mechanism of the three reclosers, thus assuring positive operation. Having three reclosers working as a unit eliminates the hazard of burning out three-phase loads by one phase locking-out while the other two phases remain closed.

INTERMITTENT FAULTS cause the three reclosers to operate independently, as a single-phase recloser.

PERMANENT FAULTS in any one phase will automatically lock-open all three reclosers. Close one and you close all three.

THREE SEPARATE TANKS—instead of one big tank—greatly reduces the possibility of phase-to-phase faults, and thus further improves your service continuity record.

For complete information on the General Electric Type FR-3 recloser ask your G-E Sales Representative for a copy of GEA-5466, or write to ***Apparatus Department, General Electric Company, Schenectady 5, New York.***

GENERAL ELECTRIC

gency outages due to breakage of parts have been eliminated. More uniform air distribution has also been evident, as well as a great reduction in unburned refuse collected in the hoppers.

Stokers at this plant are the underfeed type, 12 retorts wide and 41 tuyeres long. Since their installation, trouble on the lower half of the stokers has taken various forms, such as slag closing air openings in tuyeres, with resultant overheating and destruction of affected parts. Often molten slag stuck to the pusher mechanism, causing severe breakage of the connected drive.

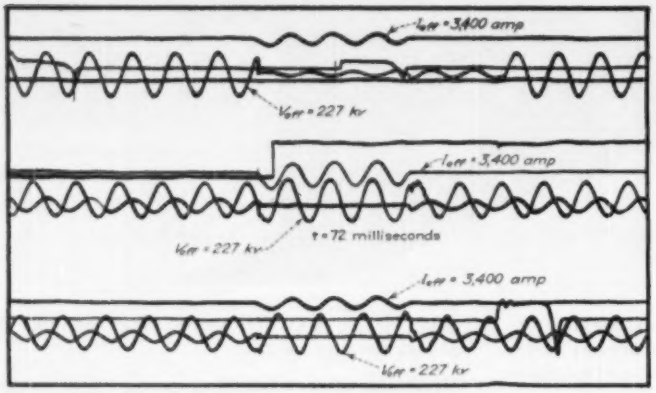
It was discovered that if a localized hot spot developed, as indicated by a faint reddening of the tuyeres, its progress could be stopped by directing a stream of water on the spot from below. If however, the tuyeres became a distinct red, spraying with water prevented further burning but cracked the tuyeres.

Because it was impossible to observe the entire stoker area continuously or to direct water on more than a few spots at a time, a header was installed underneath the stoker. Holes were drilled at intervals so that water would spray on each individual stack of tuyeres. These headers hang from the stoker supporting steel. They are placed about two-thirds the stoker length from the top of the tuyere stack and about 2 ft below the tuyeres. While this installation protected the area covered by the spray, it provided insufficient coverage to protect all tuyeres in the danger zone.

Headers were then connected to the pusher mechanism so that they would rotate through a small angle. Thus each spray covered the desired area in its particular tuyere stack, with the rapidity of traverse varying directly with stoker speed. This arrangement protected the stokers so long as the sprays functioned.

However, difficulty was experienced with nozzle stoppage when attempts were made to obtain the minimum required flow of water by throttling. Recently, strainers were installed in headers and all piping beyond the strainers was replaced with noncorrosive pipe. Results to date are very gratifying. With water pressure reduced to where sprays will just reach the tuyeres, no difficulty from stoppage has been reported in a two-week period.

• • •



CLOSE-OPEN TEST on a 220-kv single pole air blast breaker under phase-to-ground fault conditions, as recorded on the French 220-kv system by an oscillograph having 15 cathode-ray tubes. Phase-to-ground voltage was 132 kv and short circuit current reached 3,400 amp

Oscillograph for Breaker Testing has 15 Tubes

Y. C. BARON
Research Engineer
Electricite de France
Paris

DESIGNED and built by Electricite de France, a 15-cathode-ray-tube recording oscillograph for testing circuit breakers performs these two functions successively or simultaneously:

1. Records electrical magnitudes like current and voltage on photographic paper.

2. Records on photographic paper such mechanical data as operation time of tripping mechanism, time at which contacts separate, internal pressure in combustion chamber of oil pour breakers, and total operation time for an "open and close" cycle under short circuit conditions. During simultaneous recording of these two functions, records can be produced on the same strip of paper.

In the design of this instrument, advantage is taken of the fact that an electron beam can be deflected by (a) applying between the deflecting plates an electrostatic field which bends the beam in a plane parallel to the field; (b) applying an electromagnetic field outside the tube which bends the beam in a plane perpendicular to the field. It can be seen, therefore, that it is possible to realize on the same tube two sets of entirely isolated controls of the beam.

If it is found necessary to record simultaneously two distinct secondary phenomena on the same tube, it would be possible to use the electromagnetic deflecting coils fed with dc for one of them and the electrostatic deflecting plate set fed with audio frequency voltage for the other. However, use of electromagnetic deflection coils implies the necessity of a suitable mu-metal shielding around the tube to avoid any interaction between the tubes and to protect the tube against stray current fields.

Control grid voltage is such that spots appear only during the recording period. The voltage is modified conveniently at this moment by the closing of a relay, which is operated in series with the electromagnetic clutch of a paper-driving mechanism. The phosphor coating of the tube screen is designed to give a violet actinic light. Outside diameter of the tubes is small, owing to the necessity of locating a great number of them in a restricted space. An outside diameter of 2.76 in. has proved convenient.

The apparatus consists essentially of these parts, all mounted on the same frame: The 15-tube set; high

Abstracted from a paper presented in "Revue Generale de l'Electricite."

ROUGHLY HALF OF ALL DISTRIBUTION TRANSFORMER FAILURES CAN BE CHARGED TO LIGHTNING. That's typical experience. However, in Spirakore® transformers delivered since late 1943, lightning failures have been almost insignificant!

There's a reason for this. Back in 1943 G-E research facilities enabled our engineers to make important discoveries about impulse strength. As a result, design improvements were made in small, low- and medium-voltage distribution transformers. The new G-E transformers—built to live with lightning—are improving operating records all over the country.

In all respects Spirakore leads the field. It's the finest distribution transformer we have ever made—the finest you can buy.

Apparatus Dept., General Electric Co., Schenectady 5, N. Y.

GENERAL ELECTRIC

voltage supply and cathode heating unit with control panel for framing, focusing and brightness adjustment; the optical system; paper storage driving mechanism with exposed paper containers; and the driving motor, its gear box and magnetic clutch.

Tubes are designed for operation at the same voltage, ie, from 1,250 to 2,500 v, for both electron gun and post-acceleration auxiliary anode. Tubes are set horizontally in rows of three, each row being displaced with respect to the lower one by 1.78 in., in order that traces may be equally spaced so as to be spread all over the paper width range.

The driving drum has been especially designed to provide a very steady speed of the photographic paper. It has tiny needles which bite into the paper for a few mils to eliminate any gliding possibility. The storage box contains a 100-ft paper roll in widths varying from 2.37 to 9.5 in. The driving device consists of a single-phase, 1,500-rpm, 0.33-hp induction motor with a starting capacitor, and a gear box providing a speed range of the paper from 0.12 in. to 9 fps.

Illustrated is an oscillogram recorded during 220-kv breaker tests carried out in Paris on the French 220-kv system. Twelve tubes were used for these tests, recording these magnitudes:

—current on shunt

—current through current transformer

—recovery voltage across terminals of the pole

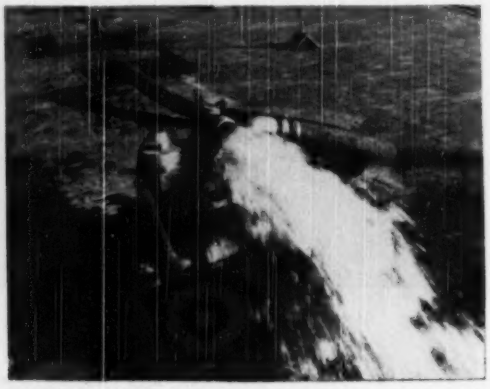
—voltages across each break

—bus voltage on each phase

—four mechanical data of breaker under test (trip relay, trip coil, contact parting time, back up breaker operation).

• • •

BORING UNDER ROADWAY with 6-in auger and earth borer is at least four times faster than the hydraulic pipe pusher previously used. Machine can be used in either a horizontal or vertical position



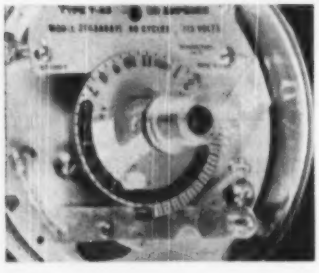
PORTABLE WATER PUMP used by underground department weighs 95 lb, has capacity of 15,000 gal/hr, can be placed on truck by two men. Two smaller pumps can be handled by one man

Underground Work Easier with Borer and Dewatering

A 5-HP AIR MOTOR with a sectional auger, now being used by Toledo Edison Co for boring under obstructions, such as roads, sidewalks, and railroads, has been found to be at least four times faster than the hydraulic pipe pusher previously used. This new machine also gives far better damage control and maintains its course more easily. It can be used either horizontally or vertically.

Three light-weight portable water pumps are used by the underground department. Two are 5,000 gal/hr pumps and the third 15,000 gal/hr. The smaller ones can be handled by one man, while two men can easily put the larger unit on a truck.

• • •



EXTERNAL RESET device permits meter reader to reset time switch with a key, instead of having to break seal, remove cover, position dial, replace cover and reseal switch, an operation lasting several minutes

Reset Time Switches Quickly

GEORGE B. M. ROBERTSON
Superintendent, Meter Div
Philadelphia Electric Co
Philadelphia

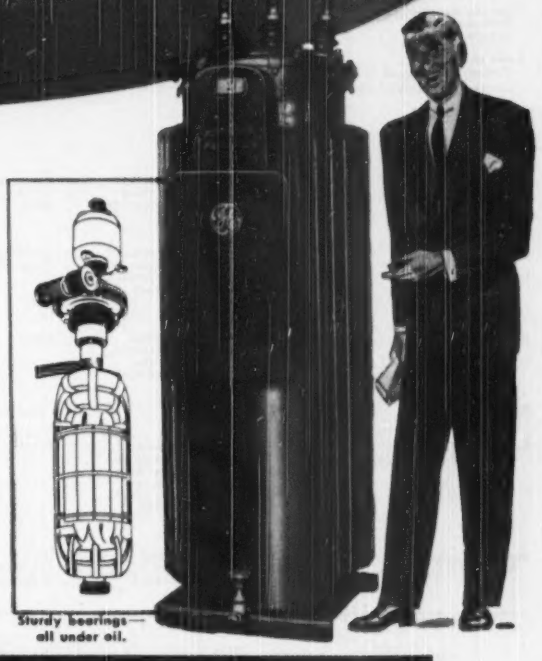
TO ELIMINATE wasted time and to insure proper attention being given to time switch resettings by meter readers, Philadelphia Electric Co has developed an external resetting device for G.E. type T-43 time switches.

This device consists of a brass bearing which also serves as a housing. The bearing is locked in place through

Requires Less Maintenance

than any other regulator you can buy...

GENERAL ELECTRIC IRS INDUCTION VOLTAGE REGULATOR



Sturdy bearings—all under oil.

★ **No contacts in the main circuit.**

★ **No cams or springs or elaborate gear trains.**

★ **No mechanical brake to adjust, no separate braking circuit.**

★ **Even the oil lasts longer—because the tank is sealed to stop all breathing.**

General Electric IRS induction voltage regulators give accurate, stepless regulation—with no time-delay. They respond immediately and will correct the voltage at an average rate of 1 per cent in 1½ seconds throughout the entire range of ±10% regulation.

And—no other regulator can match them in low maintenance costs. Ask for Bulletin GEA-2985.

Apparatus Dept., General Electric Company, Schenectady 5, New York.

GENERAL ELECTRIC

Chemical Treatment of Right-of-Way

Company	A	B	C	D	E	F
Type of Chemical and Vehicle (1)	Esters of 2,4-D and 2,4,5-T Fuel Oil	Esters of 2,4-D and 2,4,5-T Oil	Esters of 2,4-D and 2,4,5-T Oil	Ammonium Sulfamate Water	Ammonium Sulfamate Water	Esters of 2,4-D and 2,4,5-T Oil or Water
Species of Brush Treated and Average Height	All species 2.5 to 3 ft	Locust, Oak, Tulip, Poplar, Hickory, Maple Sassafras, Wild Cherry, Sumac, Briers 3 ft	All species 3 to 4 ft	Wild Cherry, Sumac, Elm, Oak, Ash, Elderberry, Hawthorn, Wild Grape, Briers, Locust, Maple and Poison Ivy 6 to 20 ft	All species 4 to 6 ft	Wide variety 4 to 5 ft
Pounds per Gallon	.....	.....	.....	0.75 lb in 1948, 1 lb in 1949	0.75 to 1 lb	.....
Gallons per Acre	15	110	6-100 qt of Concentrate to 100 gal of Oil	Varied	300 to 350	2 of Chem, 50 of Oil, 1.3 of Chem, 2 of Water
Acres Treated	30	110	1948, 93 1949, 60 new acres, 89 resprayed	548	462 in 1949	55
Cost per Acre	$35.00	$121.24	$113.00	$90 in 1948 $140 in 1949	$92.00	$40.00
Year and Season First Applied (2)	Sprayed Sept 1948 and re-sprayed Dec 1948	1948 Summer	1948 Summer and fall	1948 June to Sept	1946 Summer	1949 Summer
Year and Season Subsequent Application	.....	1949 Summer	1949 Summer and fall	1949 June to Sept 1950	1948, Fall 1949, Fall	.....
Cycle of Treating Actual or Proposed	.....	Has not been decided as yet	5 years after 1st and 2nd years	1st year, 3rd year and every 6 years thereafter (proposed)	5 years (proposed)	.....
Precautions Taken to Minimize Drift (3)	Hood over nozzle	.....	.....	None	None	.....
Type of Spray and Pressure	Hand 20 lb	Hand, 12 lb at nozzle, Power, 100 lb at nozzle	Hand and power, 60 lb	Power, 600 lb max	Power, 300 to 600 lb or 200 to 950 lb at nozzle	Power
Species on Which Most Effective	Cherry and Sumac	Tulip, Poplar, Oak, Silver Maple, Sumac, Sassafras and Briers	Sumac, Poplar, Aspen and Oak	Wild Cherry and Hawthorn	Good on all except those noted below	.....
Species on Which Less Effective	Maple, Ash and Oak	Locust, Black Oak, Hickory, Red Maple, Gum and Wild Cherry	Maple	Oak, Ash and Maple	Red Maple and Locust	.....
Kill From First Application	.....	30%	About 60%	80%	80 to 85%	90%
Conditions Found on Last Inspection (4)	Roots not dead	All existing growth appeared dead, but upon close inspection new growth was evident	Good	1948 spraying, most of small brush is down, larger brush can be pushed over. Heavy snow should level remainder. 1949 spraying, kill in general was excellent	Very good	Practically all turned brown
Remarks Concerning Root Kill (5)	Did not kill roots in 90% of cases	Very little evidence of any root kill	Too early to determine. Fair on first spray	1948 spraying, root kill was very satisfactory. 1949 spraying, too early to tell	Good on most species	.....

(1) Two companies (E, J-2) reported using wetting agent; one company (D) a sticker compound.
(2) In all cases but one (G), chemical was applied by contractor.
(3) Only four companies (D, H, I, J-3) reported complaints, all of which were minor.
(4) Inspection carried out in second half of 1949, in the Fall by most companies. It was reported generally that better results could be obtained by greater degree of coverage. No steps are being taken to eliminate standing dead brush.

Methods and results of ten power companies using various chemicals to control woody growth on transmission right-of-way—an adaption from a preliminary report by the Transmission and Distribution Committee of the Pennsylvania Electric Association.

G	H	I	J-1	J-2	J-3
Esters of 2,4-D and 2,4,5-T Water	Esters of 2,4-D and 2,4,5-T Water	Esters of 2,4-D and 2,4,5-T Water	Esters of 2,4-D and 2,4,5-T Water	Ammonium Sulfamate Water	2,4-D Oil
Briers, Poplar, Oak, Locust, Sumac, Wild Cherry, Sassafras, Hickory, and Sycamore 8 ft	All common to Appalachian Plateau 8 ft	Briers, Elm, Wild Cherry, Locust, Sumac, Poison Ivy, Sassafras, Ash, Sycamore, Beech, Virginia Creeper 4 to 6 ft	Species common to No. Eastern Penna. 2 ft	Species common to No. Eastern Penna. 7 to 8 ft	Species common to No. Eastern Penna. 7 ft
0.085 lb	0.03375 lb	0.025 lb	0.024 lb	0.5 to 1 lb	.....
120 to 125	120	0.75 gal of chem	100 to 120	300 to 350	.....
8	3,700 in 1949	446 in 1949	27 in 1949	36 in 1948	330 in 1948
.....	$30-35	$28.75	$28.00	$105.00	$40.00
1949 Summer	1946 Summer	1947 Summer used 2,4-D	1949 Summer	1948 Summer	1948 Summer
.....	1947, 1948 and 1949 Summer	1949 Summer	1950 Summer	1950 Summer	None
.....	1st year 2nd year 5th year 8th year	Once each season 1st and 2nd years, complete application. 3rd year, spot treatment	Proposed 1st and 2nd years, then as justified	Proposed 1st and 2nd years, then as justified	Proposed 1st and 2nd years, then as justified
Yes	Common sense	Use low spray	Mist gun	Special nozzles	None
Hand and power, 150 lb (Power)	Power, 250 lb average	Power, 250 to 300 lb at pump	Power, 250 lb	Power, 300 to 400 lb	Hand
Wild Cherry and Locust	All except those noted below	Briers, Wild Cherry, Elm, Poplar, Black Locust, Sassafras, Sumac, Sycamore, Virginia Creeper and Poison Ivy	Birch, Chestnut and Oak	Oak, Birch, Soft Maple and Chestnut	Sweet Fern, Poplar, Sumac and Sassafras
Hickory	Maple, Ash, Beech and Basswood	Ash, Beech and Red Maple	Laurel, Maple and Ash	Laurel, Briers and Red Maple	Chestnut, Oak, Ash, Red Maple, Hickory and Laurel
70%	60%	75%	85%	90%	10%
Cannot tell too much until Spring	Good	Most of growth stunted and dead. There were some suckers	Wilting of foliage was generally heavy	Brush dead but standing	Brush was dense and green, showing very little effect from spray
.....	.....	Root kill more effective when young brush is treated	Initial spray, too early to report	Very little resurgent growth except briers	Heavy resurgent growth from the roots

(5) Regarding efforts to treat stumps, one company (I), which hand sprayed with kerosene, said it was too early to report results. Another company (H) used equal parts of 2,4-D and 2,4,5-T at 15,000 ppm in fuel oil. This was applied with a hand spray and excellent results were obtained. A third company (E) using 2,4-D and 2,4,5-T in a spray reported that results were not very good. A fourth company (B) reported use of 2,4-D and 2,4,5-T with other ingredients, in spray form, but preferred to wait before evaluating results.

a hole in the glass cover by a hexagon nut and suitable washers. Mounted in the bearing is a triangular key stem which actuates a pusher. The pusher, made of phosphor bronze, is shaped to serve as a ratchet to prevent reverse resetting. The pusher engages a stud on the time dial plate but is free to revolve if driven by the time mechanism.

With this device the meter reader merely inserts a key to reset the switch. Operating time is only a few seconds as compared to the former time of several minutes.

"Smoke-Zone" Design Improves Distribution System

DAVID BURNS
Lines Standards and Specifications Engineer
The Detroit Edison Co
Detroit

WHEN MAINTENANCE costs on primary distribution circuits in a heavily industrialized area became excessive, Detroit Edison experimented with "smoke zone" construction to reduce the troubles. Experience to date indicates that the extra expense of this leakage-current-retardant construction has been more than justified by improved service continuity and lower maintenance cost. Pin and arm burning has been greatly reduced at all conductor supports, particularly in those conductor supports where fog-type and bowl-type insulators are used.

Outage Causes

Major causes of service outages and high maintenance were: (1) Pin, arm and pole burning; (2) hardware corrosion; and (3) flashover and corrosion on transformers and other equipment. Since many of these breakdowns occurred during storms, extra costs were involved due to the emergency nature presented by these outages.

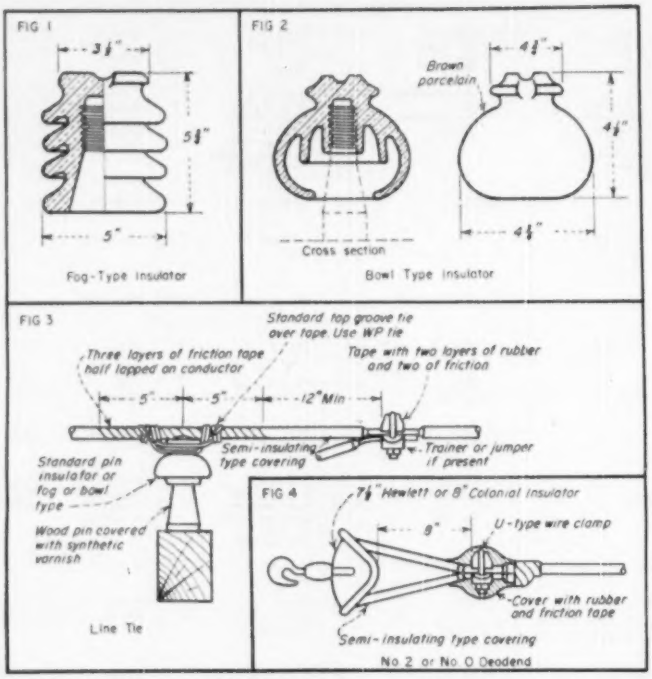
In 1941, a type of construction which would retard the flow of leakage current was developed. A specific area set aside for this improved construction included 4.8-kv delta ungrounded primary and some series lighting. Sources of atmospheric contamination in the area include cement dust in the vicinity of a large Portland cement plant; carbonaceous by-products of combustion; and water soluble salts such as sodium chloride and sodium sulphate.

Semi-insulating Covering

During the changeover, old weatherproof conductors were replaced by conductors with semi-insulating type covering. Some pin insulators were replaced by two types (see Fig 1 and 2). Wood pins with synthetic varnish coating were used in existing wood crossarms. Conductors were wrapped with friction tape before applying tie wires; wire connections were covered with insulating tape. Tape was applied under tie wires to prevent them from cutting into conductor coverings. It also added somewhat to the insulation resistance. Insulating tape was applied over tap connectors to maintain the insulation level of the conductor covering.

The type of line tie now being used is shown in Fig 3. The type of conductor deadend now in use, with the conductor passed through a porcelain insulator and the nearest break in conductor insulation at least 8 in. from the insulator, is shown immediately above in Fig 4.

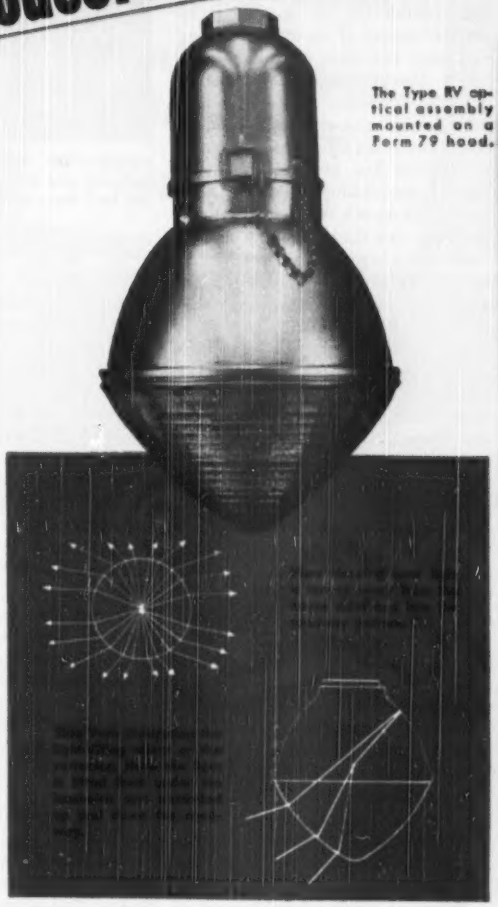
Line hardware showing signs of corrosion was replaced with new galvanized material. In 1947, all guys in part of the control area were replaced with stainless steel strand. Starting in 1949, all hardware replacements in the control area have been of new low alloy steel in all items available. Old-style transformers were replaced by transformers in which the primary bushings were the stud type.



LINE ELEMENTS used by Detroit Edison to improve service continuity and reduce maintenance costs of 4.8-kv, delta ungrounded, primary distribution circuits and some series lighting in contaminated, industrial atmosphere. Fog-type and bowl-type insulators (Fig 1 & 2) replaced pin-type insulators. Special construction and taping techniques (Fig 3) were used on tie wires, connectors and pins. Deadends (Fig 4) were made in this manner

what's **New** in street lighting

A High-Efficiency Residential Optical Assembly for Modest Budgets



The Type RV optical assembly mounted on a Form 79 hood.

General Electric offers this new high-efficiency optical assembly for safe, attractive lighting of residential or light-traffic streets at a price even modest budgets can afford.

Efficient Light Distribution

Type RV optical assembly produces a long, narrow, two-beam distribution (IES Type I), making it excellent for very long spacing (10 to 12 times mounting height). Where the desired footcandle value is about 0.2 and economy of 4,000 or 6,000-lumen lamps is needed, the Type RV is the ideal choice.

The Type RV has a newly developed reflector which directs light down into a new Holophane VERTILATERAL refractor, specially designed to turn and lift light into a carefully controlled, long, rectangular pattern.

This luminaire has been designed for Comfortable Seeing. It has deep shielding and sharp cut-off above angles of maximum candlepower for less glare—excellent side shielding to keep the light down on the road where it's wanted—a rectangular pattern of light for long economical spacing.

Flexibility

And the Type RV fits in with standardization programs. It can be mounted on any Form 79 or 101 hood. The glassware can be spun-sealed to the reflector or assembled by clamp band or roller latch. For complete information write *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

GENERAL ELECTRIC

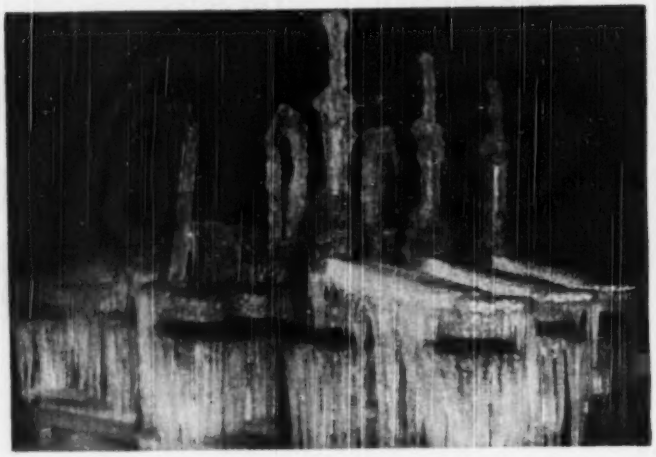
New Specification for Icing Tests on Equipment

W. R. SMITH
Substation Engineer

R. B. ANTHONY
Asst to Supt, Line and Substations
Pennsylvania Power and Light Co
Allentown, Pa.

and

J. B. OWENS
Switchgear Engineer
Westinghouse Electric Corp
East Pittsburgh, Pa.



LABORATORY ICE produced by new, high temperature, slow freeze specification closely duplicates most difficult natural ice encountered in practice. Air break switch was coated with hard, dense, bubble-free ice in 6 hr, with a 1¼-in. layer being formed on break contacts

ENGINEERS of Pennsylvania Power and Light Co have prepared a new specification for the formation by artifical means of ice used in testing switching and other electrical equipment. This specification for laboratory use duplicates as nearly as possible actual atmospheric conditions which produce ice in nature.

Previous low temperature, quick freeze specifications, which first cooled the switch to a very low temperature and then applied a moderately warm water spray, resulted in an ice coating loosely bonded to the switch and of low strength due to many air bubbles. The new specification calls for a relatively high temperature and a slow freeze. The ice thus produced is dense, hard and free from air bubbles, and has all the characteristics of the most difficult natural ice encountered under the most severe operating conditions. The new specification has been proved in cooperation with Westinghouse Electric Corp in experiments in its high power laboratory.

To test switching under ice conditions produced according to this specification, two type V, 15-kv, 400-amp, air break switches were used. They were mounted on a wooden structure in a horizontal upright position and equipped with a torsional-type operating mechanism. A spare switch casting was used to accumulate ice for impact testing. All switch surfaces had been thoroughly cleaned of grease and exposed to the weather for a considerable time before the actual test.

Rain was produced from a set of pipes which had been drilled with many small holes and placed around the outside of the structure at the level of the switch bases. Water pressure was adjusted so that the water went several feet into the air before falling onto the switches. Water supplied to the pipes was cooled to approximately 35 F and was cooled additionally in its passage through the air.

With one switch in the open position and the other closed, room temperature was dropped to approximately 35 F. Then, the precooled rain was started so that the switches would be thoroughly wet before freezing began. Spraying at temperatures above freezing was continued for approximately 1 hr while the air temperature was being lowered to the freezing point.

During the next 2 hr room temperature was lowered gradually to 25 F. Temperature was held between 25 and 30 F for the remainder of the test. Rain was applied for a total of 6 hr during which time ice was deposited on the switches at the rate of approximately ¾ in. per hour. About 1¼ in. of ice was found to have been deposited on the break contacts during this time.

Clarity and freedom from air bubbles of ice on the switches is shown in the illustration. When the test ice was struck with a hammer, it chipped but did not break off in large pieces, indicating there was a good bond between the ice and the switch parts.

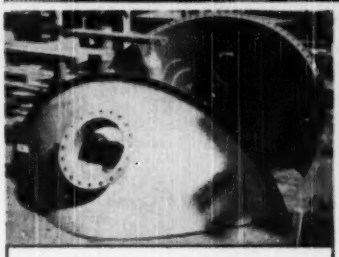
In the first test, the closed switch was opened without difficulty but the switch frozen in the open position could not be closed. After minor modifications of the switch operating mechanism, a second test was made and the switch operated successfully. Switches were operated in this subsequent test by utility engineers without undue effort, and without benefit of any handle extension or other mechanical advantage. On both the open and closed switches, a single pull of the operating handle broke the ice and started the switch parts moving. The closed switch was opened with a single continuous motion. Three blows of the blade contact against solid ice in the jaws of the open switch were required to clear the way for fully closed position.

Squeezer Arms on Truck Save Time in Storeroom

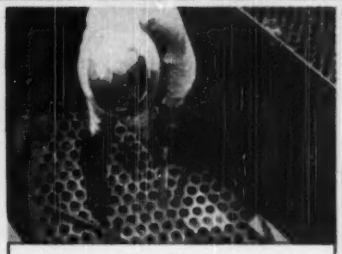
Time and trouble are saved in Virginia Electric & Power Co's Richmond storeroom by a "squeezer" arm attachment on an industrial fork-lift truck. This device, which replaces the forks, is controlled by hydraulic levers and grips the load by the sides. It has handled transformers without damage to their cases and has been used for moving coils of wire and other loads that can be gripped.

REVERE NON-FERROUS METALS USED IN GAS CONDENSER

Operating Efficiency Increased— Space Saved



THERE'S A LONG LIFE OF rugged service ahead for this three-pass gas condenser. Bottom water box shown here, as well as top water box, and baffles are made of that corrosion resistant silicon-bronze alloy—Herculoy, supplied by Revere.



SPACE SAVER—These 2" O.D. tubes measuring 22' long x .083" made it possible to erect a condenser 50' high. Fewer long tubes and fewer joints saved space, reduced labor costs. Former unit had a maximum height of only 12'. Covered much wider area.

WORM'S-EYE VIEW of gas condenser made by the Bartlett-Hayward Plant of the Koppers Company, Inc., Baltimore, Maryland, showing part of the hundreds of Arsenical Admiralty tubes supplied by Revere, fitted into place and expanded.

Under normal operating conditions, the tubes in a gas condenser are exposed to tars, moisture and other impurities from raw manufactured gas. In designing this condenser there was another consideration—brackish harbor water from an industrial area. Under these conditions a gas condenser of all steel construction wouldn't last very long. There was also another consideration—space which precluded use of the bulky cast iron condenser.

Engineers of the Bartlett Hayward Plant, Koppers Company, Incorporated got together with Revere's Technical Advisory Service and drew up specifications for materials of construction. The result was (1) A condenser shell of steel. (2) Tubes of Revere's Arsenical Admiralty metal which is inhibited to resist dezincification and also highly resistant to other forms of attack. (3) Bottom water box and top water box and baffle of Herculoy, the silicon-bronze alloy that has the corrosion resistance of copper bronze, plus the strength of mild steel. (4) Tube sheets of Naval Brass. All together nearly 40 tons of Revere non-ferrous materials.

Better heat transfer of the Admiralty tubes, and the use of longer tubes, resulted in a condenser which utilized more head room, lessened cost of installation and made possible a unit that took up less ground area.

Why don't you look into the possibility of using one of these Revere alloys or some other Revere alloy or metal in your condensers? Revere's Technical Advisory Service will be glad to work with your engineers on your problems. Just call the nearest Revere office today.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, New York

• • •

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.

Sales Offices in Principal Cities, Distributors Everywhere

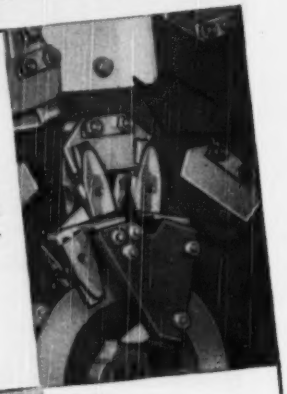
MOLONEY *LOAD* TAP CHANGERS

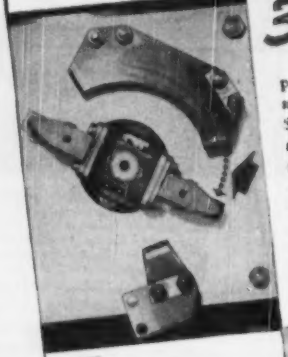
USED ON MOLONEY LOAD RATIO CONTROL TRANSFORMERS, REGULATING TRANSFORMERS, AND STEP VOLTAGE REGULATORS

Better performance of Moloney voltage regulating apparatus is due in part to the advanced design of the Load Tap Changer switch assembly. Its many advantages are largely a result of the incorporation of a separate switch for performing all arcing duty, a feature heretofore provided only on large ratings of Load Ratio Control and Power Regulating Transformers.

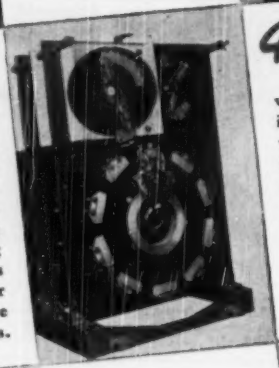
1 Arcing duty is confined to but *four* moving contacts and *two* stationary contacts per phase, through use of a separate Load Transfer Switch. Current is actually interrupted on but one moving and one stationary contact per phase in changing from one operating position to another. Photo shows front half of switch.

2 No arcing duty is imposed upon any of these Tap Selector Switch contacts, avoiding the necessity for replacement due to burning or scoring. Contacts are of hardened *copper alloy* to minimize frictional wear.





3 Greatly improved arc interrupting ability is provided through use of a separate Load Transfer Switch instead of the usual single switch arrangement which performs the dual function of breaking current and changing taps. The fewer contacts of the Load Transfer Switch make possible longer arc clearances.



4 Arcing is confined to a small area in contrast with the large area which is subjected to arcing on voltage regulating apparatus incorporating a single switch for breaking current as well as changing taps.

5 Insulating barriers in arcing area are faced with Melamine. This material is extremely resistant to the erosive action of arcs and arcing gases.

6 Wear cannot cause improper timing of the operations of the switches since not only are all parts solidly tied together by means of gears, but their timing is not critical.

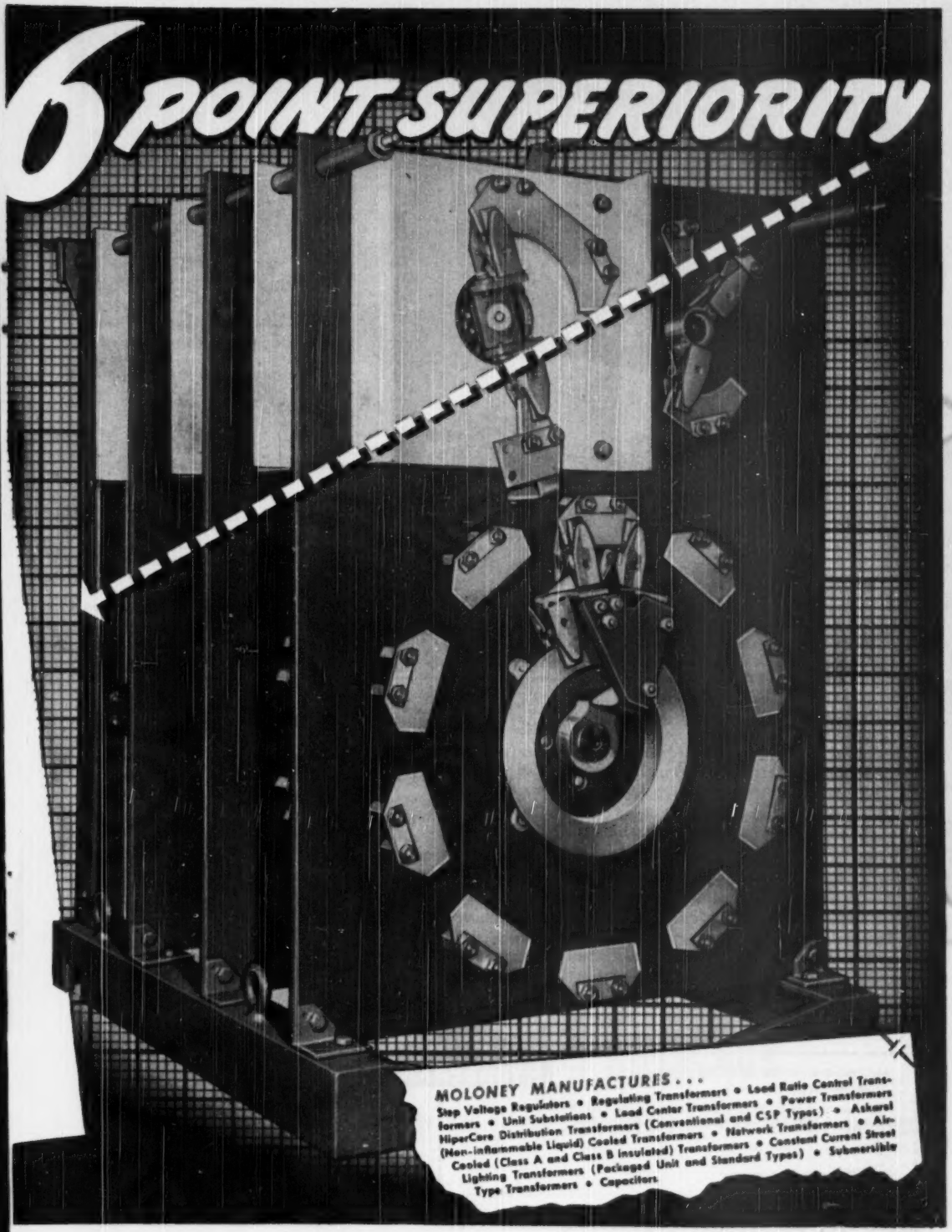
ME50-3

MOLONEY ELECTRIC CO.

Sales Offices in all Principal Cities

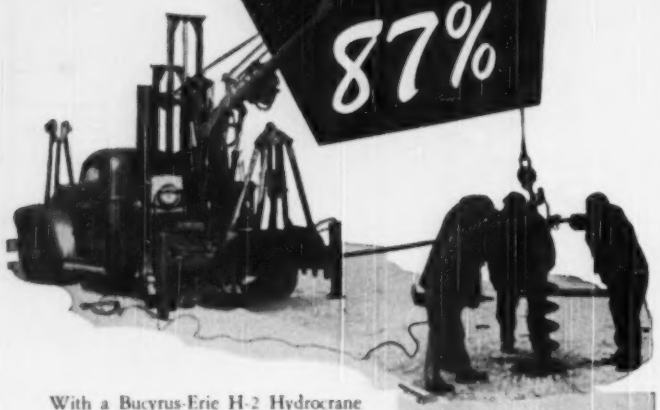
FACTORIES AT ST. LOUIS 20, MO. AND TORONTO, ONTARIO, CANADA

6 POINT SUPERIORITY



MOLONEY MANUFACTURES . . .
Step Voltage Regulators • Regulating Transformers • Load Ratio Control Transformers • Unit Substations • Load Center Transformers • Power Transformers
HiperCore Distribution Transformers (Conventional and CSP Types) • Askarel (Non-inflammable Liquid) Cooled Transformers • Network Transformers • Air-Cooled (Class A and Class B Insulated) Transformers • Constant Current Street Lighting Transformers (Packaged Unit and Standard Types) • Submersible Type Transformers • Capacitors

Hydrocrane Cuts POST HOLE DIGGING TIME 87%



With a Bucyrus-Erie H-2 Hydrocrane holding an earth auger, F. R. North Co., Rockford, Illinois bored holes for line poles at the rate of eight per hour. An auger held by a line truck derrick bored only about one an hour on the same line. A company spokesman said, "One big advantage of the Hydrocrane is that it stays on the road during drilling — the operator just swings the boom into place. On the other hand, line trucks with derricks must back up off the road onto soft shoulders or into ditches to reach the proper spot."

Here the Hydrocrane handles an earth auger on a hole boring job. Outriggers set and retract hydraulically from the operator's seat — in a matter of seconds. Two models—2-ton ¼ yard and 3-ton ⅜ yard.

North also loads poles from railroad cars to trailers with his Hydrocrane — does the job in one-third the time required with an A-frame on a truck.

Hydraulic Control Big Advantage on Pole Setting

This truck rig has proved a real standout on setting line poles — does the job quickly, easily. And its precision hydraulic control means greater safety for workers. Hydrocranes also save time setting transformers, hauling trailers, and on countless general utility jobs. Send the coupon for further information.

BUCYRUS-ERIE HYDROCRANE DIVISION
South Milwaukee, Wisconsin

BUCYRUS ERIE HYDROCRANE

BUCYRUS-ERIE HYDROCRANE DIVISION 67H50
South Milwaukee, Wisconsin

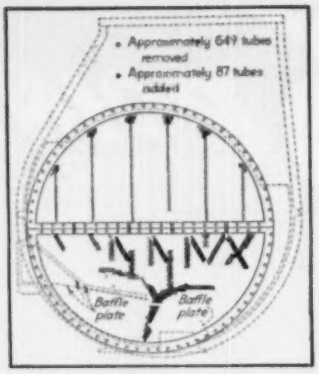
Gentlemen: I want more information on the time and money saving possibilities of the Hydrocrane.

Name.....

Company.....

Address.....

City.....State.....



RELANING REQUIRED to enable an existing 15-Mw condenser to handle the increased loading of a new 25-Mw turbo-alternator at the Market Street Station of New Orleans Public Service, Inc

Relaned Condenser Handles Increased Loading

JOHN F. VOGT, JR.
Mechanical Engineer
New Orleans Public Service, Inc

By relaning an existing 15-Mw condenser to put more tube surface to effective work, New Orleans Public Service improved the average heat transfer rate so that this condenser could handle the increased load of a new 25-Mw turbo-alternator.

The improved water rate, use of extraction steam for feedwater heating, and higher initial steam pressure and temperature in the new turbine made it possible to work out this relaning pattern in the existing condenser.

By taking advantage of the other existing facilities, including condensate pumps, motor drives, steam-jet air ejector and motor-driven circulating water pump, it is anticipated that the new unit providing 10,000-kw incremental capacity will cost less than $70 per kw.

What! Not at the Convention?

To give you all the details ELECTRICAL WORLD for June 19 will carry a full report of the EEI Atlantic City convention, including digests of all discussions.

Located at the Colgate Power House of Pacific Gas and Electric Company, these eight three-phase breaker units have individual interrupting capacities of 1,000,000 kva each. More complete details of this installation are supplied by Pacific Electric Manufacturing Corporation, builder of these breakers: "Frame mounted type JE-42-E; rating, 69 kv, 600 amperes, 1,000,000 interrupting kva. Use of sliding shoe contacts requires no critical adjustments to fix closed position. Contact pressure is not affected by wear. Other PEMCO features include closing by motor-compressed springs so that equal quantity of stored energy is released at each operation, no matter how frequent; expulsion chamber arc extinguishment, and . . ."

BUSHINGS

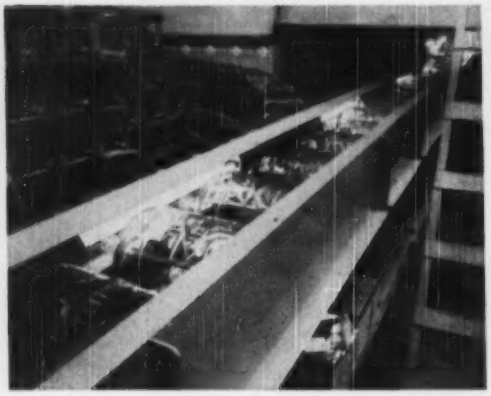
ONE OF THE FINEST COMPONENTS OF ANY CIRCUIT BREAKER

Ohio Brass

MANSFIELD • OHIO

LOAD BUILDING

RESIDENTIAL • RURAL
COMMERCIAL • INDUSTRIAL



BATTERY OF GERMICIDAL LAMPS safeguards bottle line from point where bottles emerge from the automatic bottle sterilizer to place where they are filled with sterilized water and then sealed

Westinghouse Electric Corp photo

STAINLESS STEEL STERILIZER uses 20 germicidal lamps to sterilize water immediately before being bottled. Water passes through sterilizer lengthwise outside the inner cylinder, then into outlet pipe

Germicidal Lamps Safeguard Drinking Water Purity

A NEW APPLICATION of germicidal lamps to safeguard the purity of artesian spring water as it is being bottled has recently been made at the Sparkletts Drinking Water Corp in Los Angeles, California. The production line, which takes advantage of every modern mechanical aid to achieve virtually automatic production, normally bottles up to 100,000 gal daily. To insure an absolutely pure product, the line is under germicidal lamps from the point at which the bottles emerge from the huge automatic bottle sterilizer to the place where they are sealed.

On the main production line, 20 of these 30-w tubular type lamps have been installed to cover every step of the production where bottles or water are exposed to the air. In addition, another 20 lamps of the same type are used in a specially-designed cylindrical sterilizer through which the water passes for a final intensive sterilization just before going into the sterilized bottles.

Disposer Handles Cans–Bottles–Gravel in Test

EDWARD J. ZIMMER
Director, Chicago Plumbing Testing Laboratory
Chicago

RESULTS of a year-long laboratory test on a food waste disposer unit should provide answers to some of the questions that are being asked by prospective buyers. The test put the disposer through harder wear and tear conditions than it could logically be expected to meet in the home.

In a period of one year a constant diet of fresh as well as cooked food wastes and other material was fed to the unit. The food waste amount was as close as possible equal to that from a family of eight persons.

In the test, food waste from the building was insufficient and additional waste was imported from laboratory members' homes, restaurants and other sources. Greases were added, vegetable as well as animal fat, hot liquids as well as pieces in solid state.

Everything But the Sink

Total amount of food waste entering the unit was 6,300 lb consisting of bones and meat, fresh and cooked, chicken entrails and feathers, heads and feet, fish, vegetables, fruits, including many pounds of peach pits and skins, cherries and cherry pits, strawberries, fresh and cooked, beet tops and beets, radishes, watermelons and other melons. In addition to this was added 1,000 lb of sand, 550 lb of glass bottles, pails full of gravel, several bushels of granite, 1,200 lb of newspapers, bushels of coal, cinders and ashes, tin cans and hundreds of pounds of limestone, as well as nails, tacks, screws and a few ½-in. galvanized malleable iron pipe fittings.

After the test was completed the

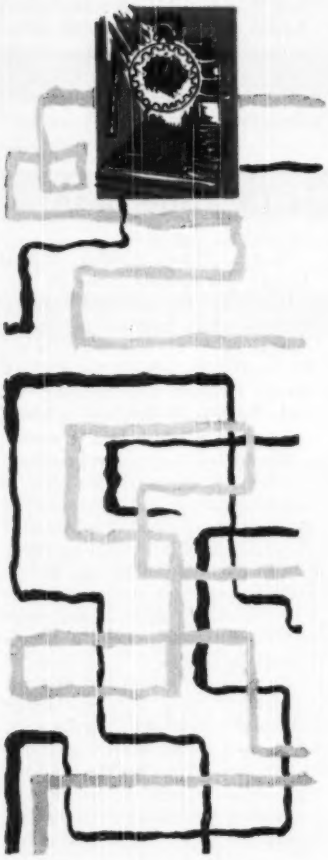
Hotpoint *Congratulates*

The 1949 Hughes Award Winners

We join the entire electric industry in extending congratulations to the winners of the 1949 Hughes Awards. Again, advancements made by utilities and individual utility employees is testimony of a good job well done.

The outstanding merchandising accomplishments attained by the participants in this competition has moved the industry forward. And as the industry progresses so do its benefits to its customers. Thus, we find the American people a step nearer the ideals of Electrical Living.

Hotpoint is glad of this opportunity to give recognition where recognition is due. We enthusiastically salute these utility companies and their employees who have been proclaimed Hughes Award winners for 1949.



Pennsylvania Power & Light Company, Allentown, Penn.
1st prize Electric Kitchen Promotion
1st prize Electric Dishwasher Promotion
2nd prize Commercial Electric Cooking Promotion

West Penn Power Company, Pittsburgh, Penn.
1st prize Electric Range Promotion
1st prize Electric Water Heater Promotion

Gulf States Utilities Company, Beaumont, Texas
2nd prize Electric Kitchen Promotion

Kentucky and West Virginia Utilities, Ashland, Ky.
2nd prize Electric Range Promotion

The Detroit Edison Company, Detroit, Mich.
2nd prize Electric Water Heater Promotion

The Toledo Edison Company, Toledo, Ohio
1st prize Commercial Electric Cooking Promotion

•

Plan Now to Enter the 1950 Competitions
Watch for details of this year's awards—to be announced soon.

•

Hotpoint Inc.
5600 West Taylor Street, Chicago 44, Illinois

piping was disassembled carefully and inspected for adherance, sediment and points of obstruction. A slight amount of sediment was found in the entire length of the horizontal waste pipe, but in no case in excess of ¼ in. in depth.

Slight grease deposits were found along the top edge of the pipe. Where possible, clean-outs were installed at each of the 90 deg bends. In the opening opposite the direction of flow, deposits of paper pulp, approximately the diameter of the bore of the fitting, were found. The house sewer of the laboratory building was also inspected and showed no sediment and no grease deposits. At the end of the test a greater amount of water was required per lb of waste processed by the disposer.

Grease Traps

Discussions were held as to the necessity or practicability of grease interceptors, grease traps or catch basins in conjunction with these units. When food waste units were connected to grease traps of various manufactured interceptors and installed as close as possible to the unit, no interception was obtained because of the high velocity of the waste water through the unit, when the sink basin contained a large enough volume of water to create a static head in the inlet of the food waste unit.

Several persons interviewed spoke of field installations with and without interceptors and/or catch basins.

Tests in the Home

Following the laboratory tests the author carried research into his home and installed two food waste units, one in the kitchen and one in a sink in the basement. He imported food wastes to create a heavy load on the stack and the catch basins, as these units were connected to a single stack which empties into the catch basin. It was found that a mat about eight inches in thickness had formed on the fluid in the catch basin and was an odorous mess. The mat and the odors disappeared after a rain storm because the down spouts from the rain gutters emptied into the basin, and cleaned it out.

Periodic inspection of the house drain was made through clean-outs provided. After six and one-half months of constant use, no grease or residual waste has been found in the house drain.

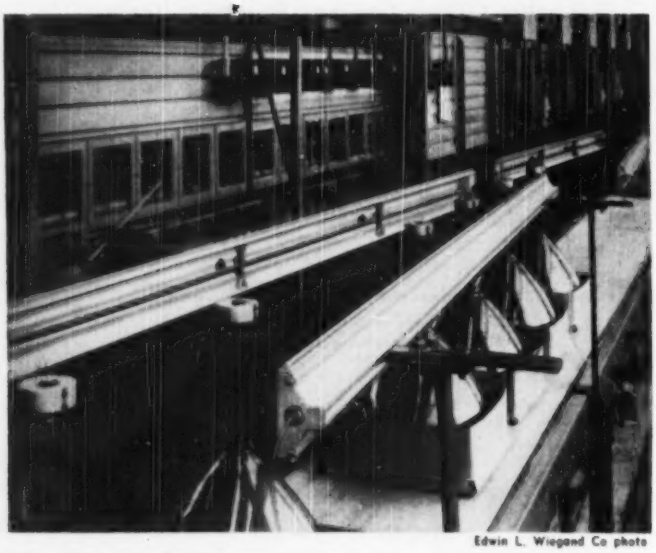
When the stack emptied into a grease interceptor, no separation was obtained because of the velocity the wastes obtained flowing through the stack and interceptor.

In laboratory tests it was found that in using hot water the grease adhered to the side walls of the pipe in proportion to the temperature. That is, water above 110 F would deposit grease on the side walls of the pipe. Water at 170 F would definitely cause the obstruction of the waste lines a greater distance from the unit than water of 140 F.

Test Results

As a result of laboratory and field testing, it was concluded that all food waste disposal units should be installed with cold water as a vehicle and that in all home installations, interceptors and/or catch basins are unsanitary. This is because of the filth involved when disassembled or cleaned and the obnoxious odors from them.

Infrared Radiant Heaters Set Cement in TV Tube Base



Edwin L. Wiegand Co photo

INFRARED RADIANT HEATERS are directed at the bases of TV tubes for drying cement. Operation is completely adjustable with no glare to annoy personnel. Investment in equipment is small compared with ovens and other equipment sometimes used for this purpose

EIGHT 230-v, 3,600-w radiant heaters, horizontally mounted, four on each side of a flat belt conveyor carrying the inverted kinescopes, completely dry the cement used to seal the ends of the tubes at the National Radio Products Co, Hatboro, Pa. Only the base of each tube is heated —the point at which heat is wanted.

The method is simple and positive; radiant heaters provide no glare to annoy personnel; the cement seal of the kinescope is properly polymerized to form a firm bond; basing operation is completely adjustable; and installation requires small capital investment compared with the ovens and other apparatus used to accomplish same results.

The radiant heaters are mounted on vertical rods, adjustable either horizontally in or out from the work so as to produce the temperatures required to polymerize the synthetic resin adhesive used, or vertically to accommodate various heights of kinescopes.

Cut Installation Costs

WITH 30% SMALLER

ROCKBESTOS

A.V.C.®

USE A SMALLER CABLE!

With a 230 ampere load you use Size 000 A.V.C. instead of 300 MCM RH*.

SAVE ON CONDUIT!

You use 2-inch conduit rather than 2½-inch conduit.

SAVE ON FITTINGS!

You use smaller fittings—bushings, couplings, terminators, connectors, etc.

SAVE ON LABOR!

Because the cable is lighter, smaller, you can pull it through the conduit easier, faster, and, of course, *cheaper.*

The more efficient current carrying capacity of Rockbestos A.V.C. means plenty of savings for you. Write for the booklet "Cut Current Carrying Costs."

*Comparison with Type RH, 3 conductors in conduit, 40°C — (104°F). See Chapter X, National Electrical Code.

ROCKBESTOS PRODUCTS CORPORATION

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Pittsburgh • St. Louis • New Orleans • Los Angeles • Oakland, Calif.

Hi ...Your best buy

*Rockbestos A.V.C. has a Higher Ampere Rating

GOOD EQUIPMENT
CAN MEAN THE DIFFERENCE
when BARTLETT does
your
LINE CLEARANCE
YOU know the difference in time and efficiency good equipment makes. It's just one more reason why so many utility companies rely on Bartlett. More equipment and better equipment . . . up-to-date and maintained in top condition. This assures speed and clean work that reflects to your credit. The name Bartlett means the best in tree work . . . and your customers know it.
YOU receive plus value when you retain Bartlett. Play safe; your name and prestige is at stake, too. Call our local office in your community or write direct for our nearest representative to call.
BARTLETT SERVICE MEANS
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• TRAINED MEN
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• CAREFUL WORK
• PROMPT SERVICE
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LOCAL OFFICES: Rutland, Windsor, Vt.; Milford, Peterboro, Rochester, N. H.; Cambridge, Framingham, Manchester, Osterville, Pittsfield, Mass.; Providence, R. I.; Danbury, Hartford, New Canaan, New Haven, Stamford, Westport, Conn.; Islip, Kingston, Monroe, Middletown, New York, Peekskill, Southampton, Syracuse, Westbury, White Plains, N. Y.; Bernardsville, Morristown, Orange, N. J.; Chambersburg, Paoli, Philadelphia (Cynwyd), York, Pa.; Wilmington, Del.; Bethesda, Easton, Towson, Md.; Ashland, Ky.; Lancaster, Portsmouth, Ohio; Charlottesville, Lynchburg, Roanoke, Va.; Bluefield, Charleston, Huntington, W. Va.;
Tenn.)

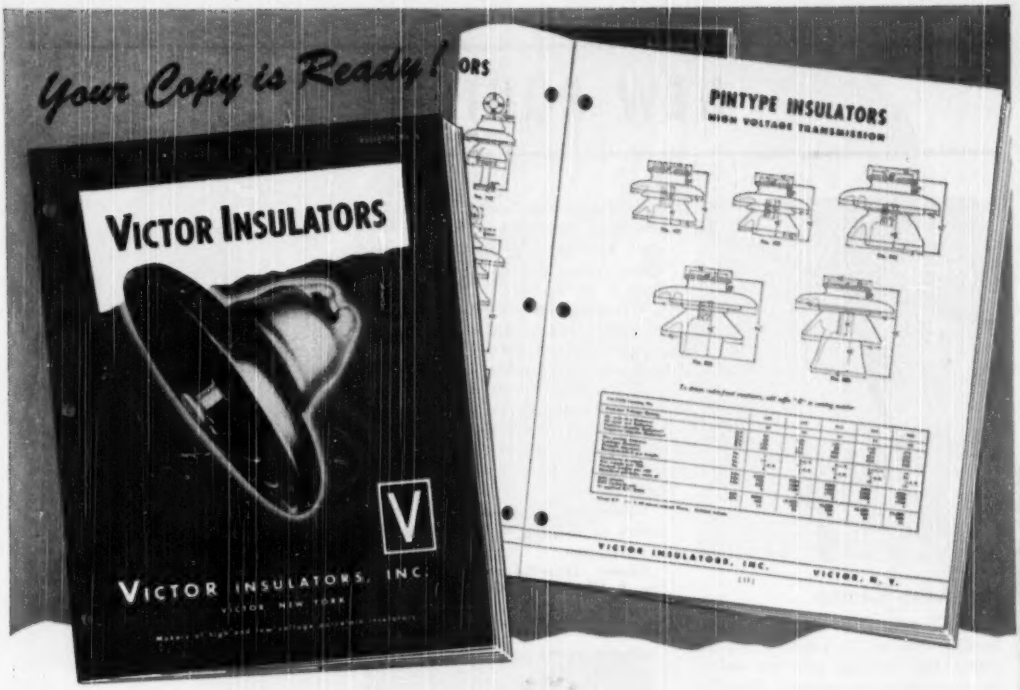
INDUSTRIAL BRIEFS

Planned Materials Handling system, properly integrated with production, at the new Philadelphia Division plant of Yale & Towne Mfg Co, reduced costs and increased output. One example of the cost-saving produced is the movement economy involved in a typical part. In the old plant the part had 22 operations and moved 45 times for a total distance of 10,140 ft, compared with a travel of 3,380 ft in the new plant —a saving of 67%.—Chas. S. Schroeder, Dir of Engineering, Phila. Div, Yale & Towne Mfg Co.

Electronic Motor Control drives used to control the rewinding lines as a function of wire tension at a wire mill at Muney, Pa., tripled production and virtually eliminated wire breakage. The reel speed is automatically slowed down to allow for coil build-up and the tension is thus held uniform throughout the winding operation. Speeds are three times greater than was previously possible with the equipment replaced.—R. D. Faytinger, Industrial Control Specialist, G.E. Co, Pittsburgh, Pa.

Relighting and Repainting at the Bureau of Internal Revenue, Washington, D. C., increased office production 5½%. The gain in production paid off in six months time. The new installation producing 50 ft-c replaced the old enclosing globe type equipment which produced only 10 ft-c. This increase in production resulted in spite of the fact that the new forms handled were much more involved and elaborate.—E. A. Linsday, Lamp Dept, G.E. Co, Nela Park.

Infrared Heaters flow sealing material in storage battery cases at the National Battery Co, St. Paul, Minn. —increasing production with fewer rejects. Proper knitting of the asphalt is accomplished without any detrimental effects on batteries, heaters operate at high ambient temperatures permitting higher efficiency; control is greatly simplified and fire hazard is reduced due to elimination of gas. Four 1,100-w, 230-v, infrared radiant heaters are installed above conveyor. Batteries pass under heaters at distance of 1½ to 2-in.



VICTOR'S *ALL-NEW* CONDENSED CATALOG

HERE, in a handy 32-page catalog, are all the well-known VICTOR insulators and hardware items you'll need for any standard job.

Complete to the last detail!

You'll find "everything" in this new VICTOR catalog—low voltage pintype, guy strain, and spool insulators . . . high voltage pintype, suspension, and switch and bus insulators . . . distribution and transmission hardware (*including the new M.P.L. aluminum strain and suspension clamps*), arcing horns and fittings, and yoke sets. In addition, the catalog contains comparative insulator tables and helpful engineering data.

Designed for handy reference

1. Two indexes at the front of the catalog—one lists the insulators and hardware items by classification, the other lists them by catalog number.
2. Clear, easy-to-read diagrams and tables.
3. Catalog measures 8½" x 11"—will fit into any standard file drawer or 3-ring binder.

Order your copy today!
Just fill in and mail this coupon

VICTOR INSULATORS Inc.
10 Maple Avenue Victor, N. Y.

Please send me my copy of VICTOR'S new Condensed Catalog

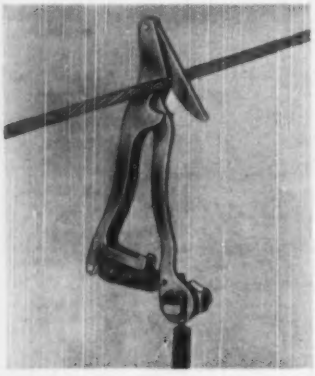
Name_____ Title_____

Company_____

Street Address_____

City_____ Zone____ State_____

NEW EQUIPMENT



Hot Line Clamp

BY WEDGING a standard hook stick between legs of the Kantfreze hot line clamp, the clamping jaws are opened for installation or removal. Manufacturer reports that amount of contraction or expansion of the main conductor will not prevent the stainless steel spring from maintaining high pressure on the clamping jaws.

Clamping members are said to be fabricated from hard drawn copper. They are available for copper-to-copper connections or for connection of wires of like or unlike metals. Wire sizes which can be handled with copper-to-copper connections are: Main, No. 6 Sol. to 2/0 Str.; tap, No. 4 Sol. max. For the all-purpose clamp the sizes are: Main, No. 0 ACSR; tap, No. 6 ACSR max.

W. N. Matthews Corp, 3850 Delor St, St. Louis 16, Mo.

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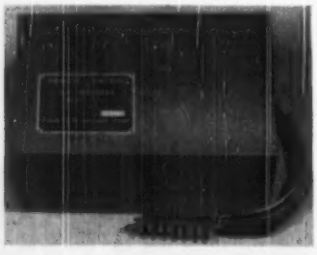

DC Welder Remote Control

CONTROLS of ac-driven dc arc welding machines are transferred to the electrode holder by an attachment called the Remote Control for DC Welders. With the device it is possible to start and stop the welding machine, select polarity, and regulate the heat right at the holder.

The attachment consists of two parts: the control box housed in stainless steel which mounts on the welding machine; and a standard holder equipped with a special grip. The holder proper is a replaceable standard make. One of two control knobs starts the machine with either straight or reversed polarity. The other knob adjusts the heat with stepless control.

Equipment is available for various makes of 200, 300, and 400-amp welding machines.

Foster Transformer Co, Colerain Ave & Dhonau St, Cincinnati, Ohio

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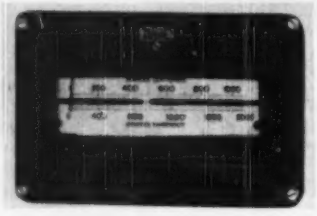


Pyrometer

WHERE SIZE of heating equipment or space limitations require use of a smaller instrument, the Model 192 indicating pyrometer is said to be applicable. It is made for flush and surface mounting.

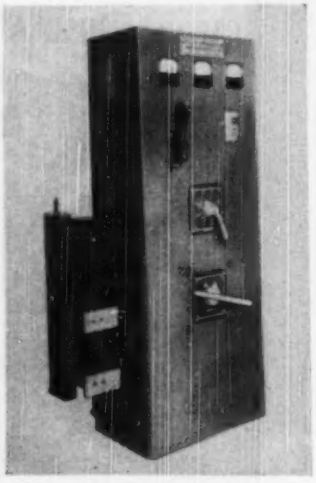
The "edgewise" movement with Alnico V magnet and mirrored scale is reported to be fully compensated and enclosed in a dustproof housing. Front dimensions are 7½ x 5 in. Details are in Bulletin D302-5.

Wheelco Instruments Co, 847 W. Harrison St, Chicago 7, Ill.

•

Heavy-Current Transformer

A LOW-VOLTAGE heavy-current transformer with control panel has been designed for heating applications. By arranging tap changing switches, any one of the 16 voltages may be selected. Switches are interlocked to prevent their operation with load on the transformer. Control equipment also includes a magnetic contactor and indicating meters for voltage and current.



The transformer is available in kva capacities up to 500, and in any required combination of voltages and frequencies. Illustrated is a 40-kva unit for 440-v supply, secondary voltages ranging from 25 to 100 v with secondary current up to 1,600 amp.

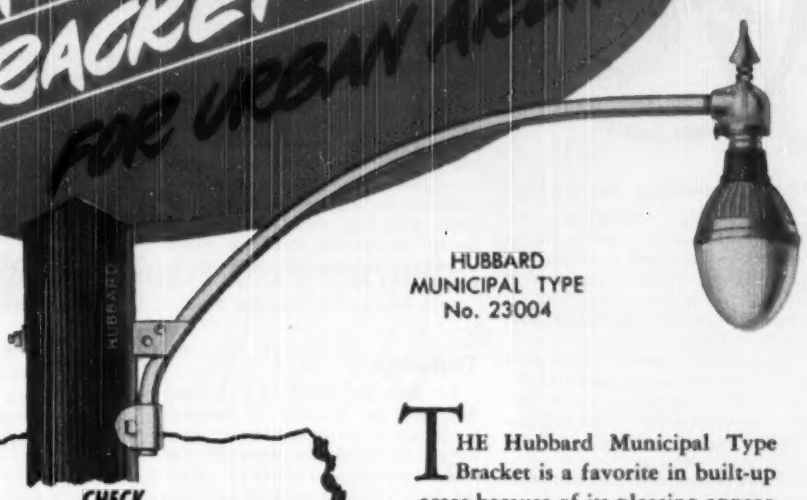
Eisler Engineering Co, Inc, 750 S. 13th St, Newark 3, N. J.

•

Power Fuse

INTERRUPTING CAPACITY of Type EJ-6 current-limiting power fuse is said to be 100,000 amp. The fuse is designed for applications on low-voltage circuits where available short-circuit current is above operating range of conventional NE Code standard fuses. Specific applications include protection for branch feeders, motor starters, lighting circuits

THE MOST POPULAR BRACKET DESIGN FOR URBAN AREAS



HUBBARD
MUNICIPAL TYPE
No. 23004

CHECK
THESE ADVANTAGES

- ✓ All welded construction throughout
- ✓ Requires small pole mounting space
- ✓ Meets all EEI-NEMA lighting specifications
- ✓ "Keyhole," basic feature of pole attachment, permits installation by one man
- ✓ Simplicity of design means low cost
- ✓ Permanently aligned at factory
- ✓ "Free flowing" internal wiring—no sharp bends and no obstructions—wiring pushes through with a minimum of resistance

THE Hubbard Municipal Type Bracket is a favorite in built-up areas because of its pleasing appearance and adaptability. The bracket is internally wired and adaptable to either internally or externally wired systems. It may be installed close to the top of the pole for maximum elevation. It is easily installed by one man, comes in nominal lengths of 3, 4, 5, and 6 feet, with rises from 16 to 26 inches.

Write for Literature

HUBBARD AND COMPANY
ESTABLISHED 1843
PITTSBURGH • CHICAGO • OAKLAND, CALIFORNIA
"Hang the load on Hubbard Hardware!"

and control power circuits.

Four basic cartridge sizes—30, 60, 100, and 200 amp—are available in voltage ratings of 250 and 600 v.

General Electric Co, Apparatus Dept, Schenectady 5, N. Y.

•

Phase Sequence Indicator

PORTABLE PHASE sequence indicator, Model K-3, may be used in testing polyphase circuits and apparatus. To determine phase sequence, whether ABC or CBA, leads are clipped on, the button pushed, and direction of disk rotation noted.

The indicator is built for 60 to 600-v circuits. By raising the minimum circuit voltage above 60 v, it can be used for a maximum frequency of 400 cps. Thus, it can be used to check 180-c circuits of 200 v and more.

Electrical Facilities, Inc, 4236 Holden St, Oakland 8, Calif.

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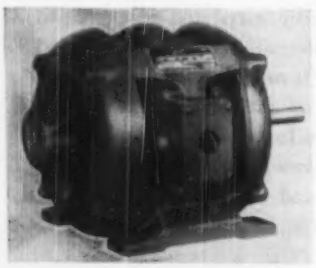
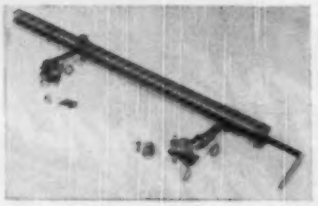


Textile Motor

GENERAL PURPOSE textile motors are intended for use where the motor is subjected to an unusual amount of lint. Oven-cured plastic insulation is said to hold the winding in a rigid mass and enclose the coil ends. They are open rated at 40 C. Stator and rotor iron is locked and keyed in position under pressure. Terminal boxes and mounting feet are cast integral with the frame.

Century Electric Co, 1806 Pine St, St. Louis 3, Mo.



Deadend Tool

TO SPEED UP and simplify changing of defective insulators on double insulator strings, the Double Deadend Tool has been designed. It is said to take up the strain on one string of insulators at a time, leaving the other string in tension. This eliminates excessive strain on both conductor and crossarm since little slack need be pulled before insulators are removed.

The strain arms fit flat steel strain yokes up to ¾ in. thick. Adapters are furnished for engaging malleable iron yokes up to 2 in. thick. The board of the tool is specially treated to retard moisture absorption and is tested to withstand 75 kv per ft.

A. B. Chance Co, Centralia, Mo.

•

Thyratron

A THREE-ELECTRODE, temperature-free tube, the WL-5796, is designed for industrial control and ignitor firing service. The tube can reportedly be used in polyphase rectifiers on inductive loads with very small or no cushioning circuits. Maximum commutation factor rating is 10.

Maximum peak anode voltage, both inverse and forward, is 1,500 v. In ignito, firing applications, maximum cathode current peak is 30 amp, 0.5 amp avg. For general control service, these values are, respectively, 20 and 1.6 amp.

Westinghouse Lamp Div, Bloomfield, N. J.

MORE NEW EQUIPMENT

Just Received

Appearing Next Issue

SECTIONALIZING DEVICE
Unit capable of serving one load from either or two feeders

LEAKING INSULATOR DETECTOR
Leaking or dirty insulators, corona arcs reportedly detected

TRANSFORMER OIL INHIBITOR
Fourteen-fold increase in life of insulating oil is claimed

AERIAL REVOLVING LADDER
Places a workman on a platform 35 ft in the air in 18 sec

Plastic Insulated Wire

BOTH the plastic insulation and sheath and the glass fiber reinforcement are being used on A-Z Cables Moist or corrosive atmospheres, temperature extremes, fungus growth, fibrous coverings and bulky construction, it is claimed, are no longer problems. The cable is now available in two-conductor No. 14 and 12 sizes, with three-conductor assemblies in these sizes to be available soon.

The Plastic Wire & Cable Corp, East Main St, Jewett City, Conn.

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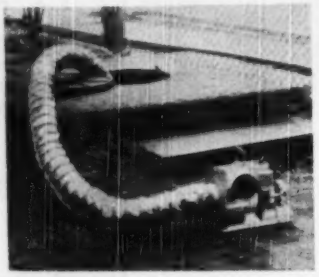


Flexible Tubing

MANHOLE PURGING and air supply are uses of a new flexible tubing called Spiratube. It may reportedly be used for ducting requirements from 3 to 30 in. ID for air or light solids. The cotton duck walls of standard tubes are coated with neoprene.

Characteristics of the 8-in. ID tube include: Weight—as little as 0.64 lb per lin ft; strength—vacuum to 25 in. Hg, or 170 psi; retractability—from 15 ft to 23 ft (87% cubic reduction). Further descriptive matter appears in Catalog 5-4.

Flexible Tubing Corp, Branford, Conn.

•

Voltage Tester

USE of a new voltage tester is reported to facilitate location of blown fuses, determine whether or not transformer tanks, metal covers or cases are grounded or energized, and warn of

YOU CAN BE SURE.. IF IT'S
Westinghouse

IT TAKES SEPARATE UNIT CONSTRUCTION FOR *Fast Meter Assembly* *

Meters made like this save money. Take one apart. See how it's made. Compare.

Notice how the Westinghouse meter practically assembles itself. There's no adjusting or fitting. The elements are *made* to fit together. That comes from precision manufacture.

And when you reassemble the meter . . . *every unit retains perfect calibration.* Every unit can be replaced in the field. All you need is a few minutes and a screw driver.

That's the story. Meters so perfectly made . . . so dependable their accuracy holds for years and years . . . without bearing replacement . . . even without attention. Your own service records will prove it!

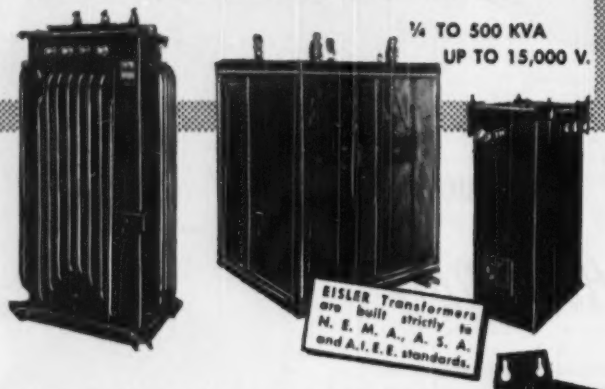
Want more proof? Call your nearest Westinghouse office or write for the new booklet, B-4665, "What It Takes for Long-time, Low-cost Metering." Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-40371

***A VITAL PART OF LONG-TIME, LOW-COST METERING**

Westinghouse METERS

EISLER
TRANSFORMERS
STANDARD • SPECIAL
AIR • OIL • WATER-COOLED
for
POWER DISTRIBUTION • LIGHTING •
AUTO • ELECTRIC FURNACE •
HEATING • PHASE CHANGING •
WELDING • GENERAL PURPOSE

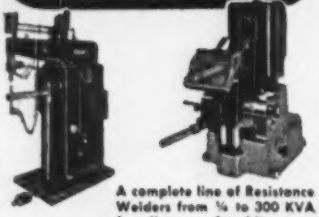
¼ TO 500 KVA
UP TO 15,000 V.



In addition to the manufacture of standard transformers the Eisler organization is especially well adapted to design and build transformers to the customer's specifications when departure from standard construction is desired. Send in your specification for quotations.

SEND FOR NEW CATALOG TR-50

EISLER
RESISTANCE WELDERS
SPOT • BUTT • GUN • SEAM



A complete line of Resistance Welders from ¼ to 300 KVA for all types of welding.

CHAS. EISLER, Pres.
EISLER ENGINEERING CO. INC.
769 SOUTH 13th ST. NEWARK 3, N. J., U. S. A.

accidental high voltage in secondary circuits. It is primarily intended for 120, 240, 480, or 600-v ac circuits, although 25 or 60-c voltage may be positively identified.

Four neon tubes, with life rated in excess of 5,000 hr, are mounted in the barrel of the probe. One lamp glows on 120 v, two on 240 v, and three on 480 v circuits to indicate voltage. The fourth lamp glows on 600 v to indicate an abnormal secondary voltage.

The Elwood Co, 410 W. Seneca St, Buffalo 2, N. Y.

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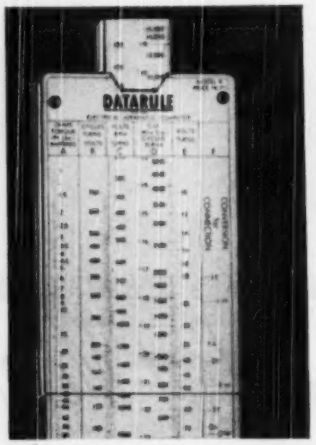


Apparatus Computer

REDESIGN PROBLEMS of many types may reportedly be solved with the Datarule, a slide-rule-like electrical apparatus computer. In making a frequency change, the Datarule will permit determination of number of turns required, resulting ohms, size wire needed, voltage which can be applied, and idle amperage. Other changes for which it may be used include those of voltage, turns, connection, speed, size wire.

The rule is of plastic construction, and has a listing giving the proper scale to use with different types of problems. A 46-page manual explains use of the computer in detail and provides much practical information for the shopman, including tables and practical problem solutions.

Brownell Distributors, Inc, 308 Canal St, New York 13, N. Y.

•

Time Switch

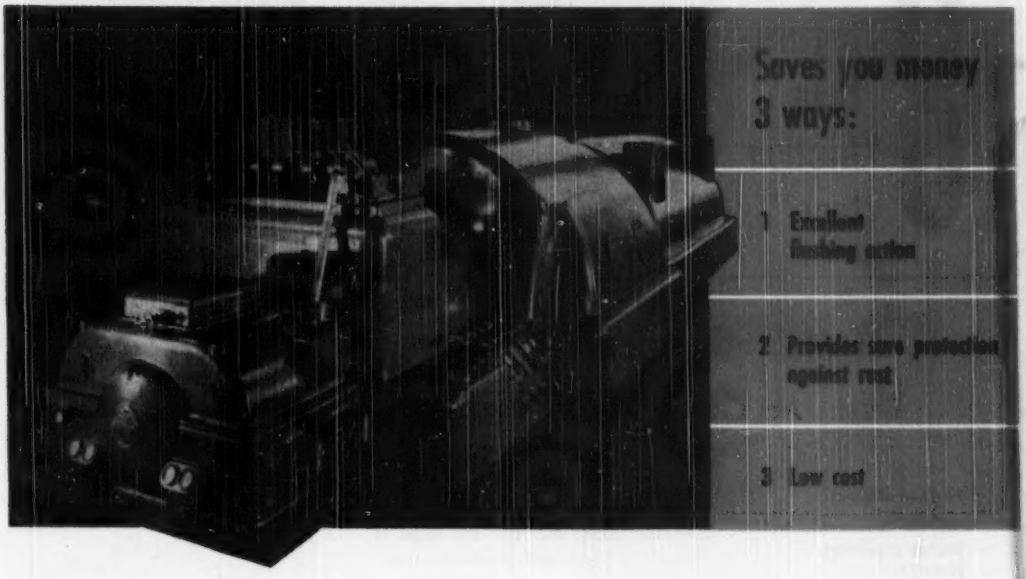
A NEW CYCLE time switch with Sunday and holiday cut-outs is set by insertion of screw pins in the programming dial. Intervals may be 15 min or more apart when used on a 24-hr cycle, 7.5 min on a 12-hr cycle,

Make sure

the lubricating system of that new turbine is clean—

flush with

Gulf Turbine Flushing Oil



The surest way to thoroughly clean the lubricating system of your new turbine is to flush with Gulf Turbine Flushing Oil. It has excellent flushing action—removes grease-type slushing compounds, welding scale, chips, sand and other loose foreign matter. It is very effective in cleaning inaccessible parts of the system.

Gulf Turbine Flushing Oil has been fortified to provide an effective rust preventive film. You can be sure that all oil bathed surfaces in the system are completely protected.

An important advantage of Gulf Turbine Flushing Oil over other types (such as certain solvents) is that the undrained portion in the turbine systems does not impair the lubricating value of the turbine oil. For Gulf Turbine Flushing Oil is itself a satisfactory lubricant.

Only one-third to one-half of a normal turbine oil fill is required for thorough flushing. Thus the expense of flushing your new turbine with low-cost Gulf Turbine Flushing Oil is nominal.

Gulf Turbine Flushing Oil is equally effective for units already in service. In these it helps remove harmful sludge and organic acids—helps flush out deposits which may have collected in the system.

For complete information on this quality product and for recommended procedure for cleaning your turbine, call in a Gulf Lubrication Engineer. Write, wire, or phone today.

GULF OIL CORPORATION · GULF REFINING COMPANY

GULF BUILDING, PITTSBURGH, PA.

Sales Offices - Warehouses

Located in principal cities and towns throughout Gulf's marketing territory

GULF INDUSTRIAL LUBRICATION

Polyken®

No. 163 Electrical Tape

8 ways better than "friction tape"

Get these "extras" for Better Performance!

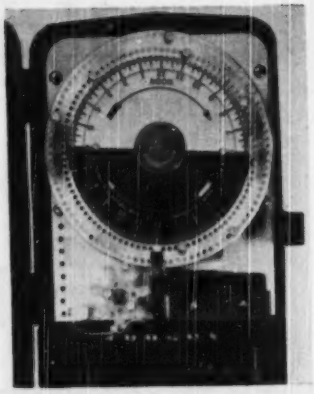
- Higher dielectric strength
- Better moisture barrier
- Less bulk—with equal strength
- Sticks quicker (higher "tack")
- Cleaner—doesn't collect grime
- Unwinds easily
- Doesn't fray
- Sticks firmly to any clean surface

Wherever you use "friction tape," you'll get better, more dependable service from POLYKEN No. 163 electrical tape. For No. 163 tape is dielectrically stronger, less bulky, more moisture-resistant . . . cleaner, too, because its non-sticky backing won't pick up grime.

No. 163 is easy to handle. It unwinds easily, sticks quickly and firmly, and is non-fraying—yet it costs you no more than most ASTM friction tapes!

Let POLYKEN No. 163 go to work for you today! Your distributor can supply you with a handy introductory package containing six ¾ in. x 90 ft. rolls.

Polyken® INDUSTRIAL TAPE
DEPARTMENT OF BAUER & BLACK DIVISION OF THE KENDALL COMPANY
322 W. ADAMS ST., CHICAGO 6



and as little as 37.5 sec when used on an hourly cycle basis. The switch may be used as a control for automatic machinery, heating, ventilating, or compressor systems.

Series 70 Cycle Master has a capacity of 10 amp on 110 v, 60 c; Series 80 has a capacity of 20 amp. Both series are available in models with or without the holiday cut-out, spst through dpdt, and with four, five or eight terminals, depending on contact arrangement. Eight pins are supplied with each unit.

Automatic Electric Manufacturing Co, Mankato, Minn.

•

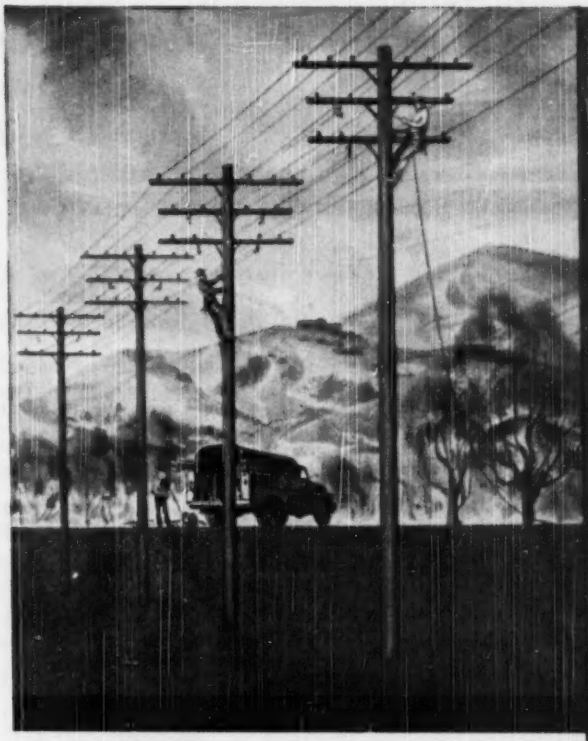
MAGNETIC SWEEPER—Operating like a carpet sweeper, this rotary magnet reportedly attracts ferrous materials which spread over its circumference to a thickness of about ⅜ in. Sizes range from about 1 to 3 ft.

Eriez Manufacturing Co, Erie, Pa.

•

Vibrator Analyzer

ADJUSTABLE power supply and vibrator analyzer are combined in the Model AR-3 Electrox for testing two-way radio communication systems, auto radios, or other equipment using 6-v vibrators. The equipment is said to detect defective vibrators and predict failures. It measures starting voltage.



Specify **penta-protected POLES**
chlorophenol

Leading light, power and telephone companies are using poles treated with PENTA in constantly increasing quantities. There's a good reason for this trend—for PENTAchlorophenol has many advantages.

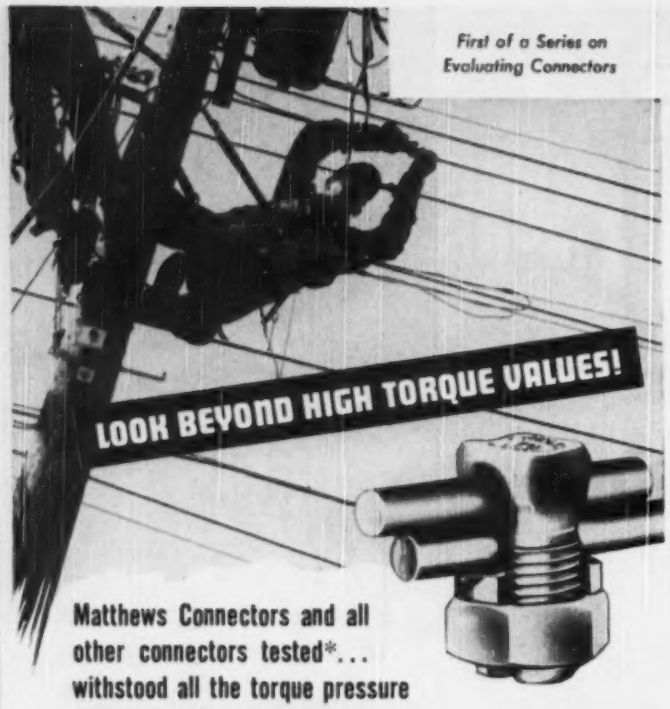
PENTA protection is *clean* protection—permits a *full length* preservative treatment with no fear of complaint from customers or line crews. PENTA gives long lasting *proved* protection against decay and termites. Its remarkably low solubility and volatility mean it stays in the wood under the most adverse conditions.

For the "over-all treatment" specify PENTA. For more information about this *modern* wood preservative, write to Dow, Dept. PE 40A.

THE DOW CHEMICAL COMPANY
MIDLAND, MICHIGAN

THE CLEAN WOOD PRESERVATIVE

DOW
penta-
chlorophenol



Matthews Connectors and all other connectors tested*... withstood all the torque pressure that linemen could apply

HERE ARE REALLY IMPORTANT CONSIDERATIONS IN CONNECTOR SELECTION...

Coefficients of Expansion and Contraction of connector and copper conductor should be exactly equal to assure constant retention of wire pressures, regardless of changes in ambient temperatures.

Electrical and Thermal Conductivity of connector should equal that of copper conductor to assure a low resistance connection.

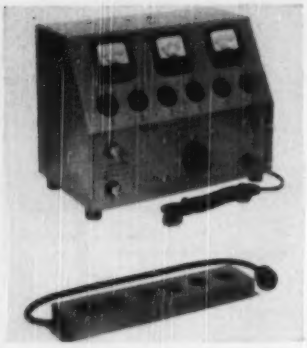
Hardness and Elasticity of connector and conductor should be equal to prevent damage to conductor in tightening.

Only *Matthews Nutype Connectors* (99.9+% Copper) give you these advantages PLUS *maintained torque*—for a positive, longer-lasting connection.

* Impartial field tests conducted by a leading utility showed that previously installed connectors of *all* makes when tested with a torque wrench in no case even approached by as much as 50% the maximum torque values claimed for them by leading manufacturers, due in large measure to the tools and gloves linesmen must use and the positions they must take while tightening connectors.

Write for further information

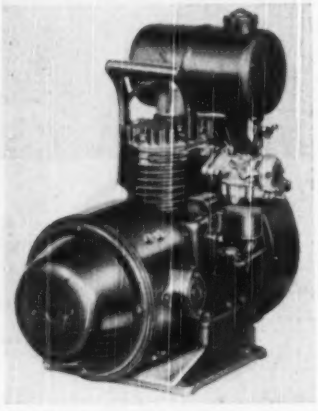
W. N. MATTHEWS CORPORATION
3844 DELOR ST. • ST. LOUIS, MO.
ENGINEERS and MANUFACTURERS SINCE 1899



current consumption, output voltage, and indicates irregular operation. Provision has been made for attachment of a standard oscilloscope to observe wave form. Less common types of vibrators can be tested by plugging them into an accessory adapter strip.

Schauer Manufacturing Co, 2060 Reading Rd, Cincinnati, Ohio

•



ELECTRIC PLANT—Portable electric plants for maintenance, construction or emergency trucks are available in either 350 (shown) or 750-w models. The automatic model starts when a connected load is turned on and stops when all loads are turned off. Prime mover is a one-cylinder, air-cooled engine.

Kohler Co, Kohler, Wis.

•

Floodlight

AN ALL-PORCELAIN floodlight, Model VE-18, is a 750-1,500 w open type, suitable for construction areas, general area lighting, and minor sports areas. Average reflectivity is said to be 82% or more, and beam efficiency in excess of 70%. A new bracket extends the company's "swing-over" feature to fit this and others of its bayonet heel floodlights.

Westinghouse Electric Corp, P.O. Box 2099, Pittsburgh 30, Pa.

Sub-Stations and Power Centers

Dry-Type

Engineered to meet

Your Exact Requirements

for indoor installations

Not necessary to design or change your installation to fit a "standard"

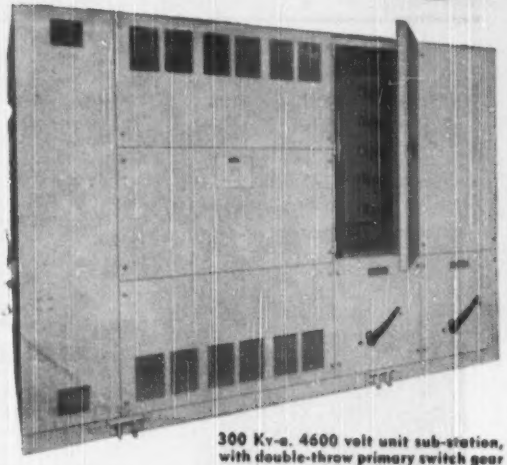
Any type of primary switch gear.
Metering—primary or secondary, to suit.
Secondary breakers, main, branch, or tie.

Interlocked or automatic throw-over. Draw-out or stationary types. Magnetic trip, or thermal, or combination. All incorporated with high quality, liberally designed

Sorgel Air-Cooled Transformers

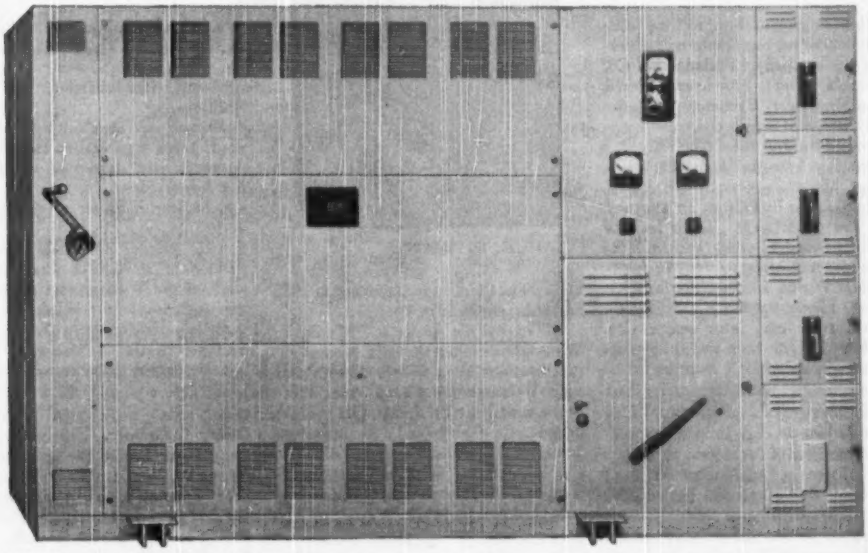
All factory wired, tested and assembled. Mounted on a substantial steel base. Shipped as a single unit or in sections, accurately co-ordinated for easy assembly on the job.

Sizes up to 2000 Kv-a. All voltages up to 15 KV.



300 Kv-a. 4600 volt unit sub-station, with double-throw primary switch gear to obtain emergency service from more than one source. Secondary main and tie breakers interlocked to obtain secondary service through another unit. Thermal type branch circuit breakers.

Send for new bulletin 450



1500 Kv-a. 13,200 volt unit, with primary disconnect, secondary metering, main and branch circuit breakers.

Sales Engineers in Principal Cities

SORGEL ELECTRIC CO., 834 West National Ave., Milwaukee 4, Wis.

Pioneers in the development and manufacturing of Air-Cooled transformers

NEWS ABOUT PEOPLE

Duquesne Light Names Fleger Chief Executive

Philip A. Fleger has been elected chairman of the board and chief executive officer of Duquesne Light Co as the

PHILIP A. FLEGER

first step in preparation for the ultimate independent ownership and operation of the company. Philadelphia Co, Duquesne's parent, has been ordered by Securities and Exchange Commission to dispose of its gas and transportation properties and then dissolve.

Fleger has been in the utility business for about 25 years. He joined Philadelphia Co in 1926 as an attorney in the law department. Later he was assistant general attorney and in 1939 became general attorney for the holding company and its subsidiaries.

In 1940 Fleger was made a vice president and two years later senior vice president. He has been executive vice president since 1946.

•

Ramon Noble, Jr, has been appointed general manager of Monterrey Railway, Light & Power Co, Ltd, Monterrey, Mex. He succeeds **S. Cerna,** who has retired after 40 years of service. Noble joined the company as general superintendent after 20 years with Porto Rico Railway, Light & Power Co, Ltd.

Goodrich W. Lineweaver, director of the Bureau of Reclamation's branch of operation and maintenance for five years, has been promoted to assistant commissioner of the bureau. He will serve in addition to the two present assistant commissioners, Kenneth Markwell and Wesley R. Nelson. **E. D. Eaton,** assistant director of operation and maintenance, has been named acting director. Lineweaver joined the bureau in 1937 after serving as secretary of Federal Power Commission from 1934-36. Eaton went to Reclamation in 1943 from the Soil Conservation Service.

•

Sharp Vice-President of Southwestern G&E

Samuel M. Sharp, chief engineer of Southwestern Gas & Electric Co, has been elected a vice president.

Sharp joined Southwestern in 1932 as Louisiana division engineer. He was

SAMUEL M. SHARP

named electrical superintendent in 1935 and chief engineer in 1941.

He started his career in 1923 in the Westinghouse Electric Corp student engineering and shop course. After a year with Westinghouse Sharp spent three years with East St. Louis (Ill.) Light & Power Co, then joined a Southwestern associate, Central & Southwest Utilities Co, in Dallas. With the last-named company he did design, engineering, and construction work.

•

C. A. MacIntyre has been named general manager of Demerara Electric Co, British Guiana subsidiary of International Power Co, Ltd, following the retirement of **H. L. Talbot.** After nine years with electric utilities in Canada MacIntyre joined Demerara as electrical superintendent in 1938.

Pennsylvania P&L Makes Mensch Vice President

Earl E. Mensch, manager of the Williamsport division of Pennsylvania Power & Light Co, has been named

EARL E. MENSCH

vice president of a new Susquehanna division formed by consolidation of the old Williamsport and Susquehanna divisions. Headquarters will be in Williamsport.

Mensch has been with PP&L and a predecessor organization for more than 40 years. He started as an office boy for Jersey Shore Electric Co in 1909 and became manager of that company in 1917.

After merger of Jersey Shore with PP&L in 1923 Mensch was made chief clerk of the Williamsport division. He was promoted to manager of the Williamsport district in 1929, assistant manager of the Williamsport division in 1932, and division manager in 1935.

•

Dewey J. DeBoer, former executive of Loup River Public Power District and Nebraska Public Power System, has been appointed to an administrative position in the operation of Consumers Public Power District. Definite assignment of his responsibilities will be made later, but primarily they will be those of general superintendent. Most recently DeBoer has been executive manager of the Copper Wire Engineering Association in Washington, D. C. He also has worked for General Electric Co; Sargent & Lundy Engineers, Chicago; and Burns & McDonnell Engi-

Ryerson Steel Service Pays 4 Ways!

1. *Quick Delivery*

Maintenance jobs keep moving—production delays are avoided when you call Ryerson for promptly needed steel. Thirteen conveniently located Ryerson plants mean shorter shipping distances, assure fast delivery of your requirements to any point in the nation.

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Careful specifying and checking of all stocks assures uniform high quality—Ryerson Certified Steel. Careful handling of your orders by experienced personnel assures accurate compliance with your specifications.

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With large, diversified Ryerson stocks nearby, you can cut costs by holding your own inventory at a practical working level. Ryerson stocks serve as your inventory reserve. You can draw on these stocks for almost any current need.

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To help you solve your steel problems, Ryerson steel specialists will gladly counsel with you. Their recommendations are backed by more than a century of experience. You can depend on us for prompt, personal service whether you need a single bar or a carload.

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BARS—carbon & alloy, hot rolled & cold finished
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JOSEPH T. RYERSON & SON, INC. PLANTS AT: NEW YORK • BOSTON • PHILADELPHIA • DETROIT • CINCINNATI CLEVELAND • PITTSBURGH • BUFFALO • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO

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First Choice for

PERMANENCE
HOLDING POWER
LONG LIFE
SAFETY

They speed up work and provide dependable anchorage in new construction and maintenance. Quick and easy to install — made of tough rust-resistant malleable iron—their holding power "tops" all others. Available two-way, three-way, four-way and cone types. Write for facts.

AN EXCLUSIVE EVERSTICK FEATURE
Exclusive Everstick nut housing. Locks anchor firmly on rod. No chance of rod slipping thru anchor.

EVERSTICK ANCHOR CO.
Manufacturer of "The Anchor of Merit"
FAIRFIELD, IOWA

neering Co, Kansas City. From 1942 to 1943 he was chief power engineer in the power division of the Office of War Utilities.

•

Fred Pillsbury President of Century Electric Co

Fred H. Pillsbury has been named president of Century Electric Co, St. Louis.

He succeeds his father, Edwin S. Pillsbury, one of the founders of the company and its president since 1914. The older Pillsbury will continue as chairman of the board of directors.

FRED H. PILLSBURY

Fred Pillsbury has been vice president in charge of operations since last July and a member of the board since 1942. He joined the company in 1927. The new president is active in the Engineers Club of St. Louis.

Two other sons of the retiring president, Joyce and William Pillsbury, also are members of the board.

•

O. L. Norman, who resigned recently as general manager of Salt River Valley Water Users Association, has been appointed assistant to the president of the National Association of Electric Companies. His headquarters will be in Washington, D. C. Norman joined the Water Users three years ago as general manager. When the association was divided into electrical production and irrigation operations for auditing purposes, he resigned, claiming he had been left responsibility without authority.

Lloyd Black, assistant plant manager of Line Material Co's transformer plant at Zanesville, Ohio, has been named manager. **A. H. Rentner** who has managed the plant since its establishment in 1938, is retiring. Black came to the plant in 1946. Before that he had served as district manager for Ban-

Your Town
can Have Beautiful
WELL-LIGHTED STREETS
with
KERRIGAN
STANDARDS
Like These . . . .

City of Lawrenceburg installation showing new Kerrigan Standards beside antiquated lamp posts

. . . . With KERRIGAN Weldforged LIGHTING STANDARDS, designed and engineered to make night-driving in your town just like day . . . Standards that meet the highest engineering standards for highway and street lighting.

. . . . Notice what one progressive Tennessee town did to light its streets; then check the Kerrigan specifications below to see how much more Kerrigan Standards offer you.

- ✓ Shafts (20', 25', & 30') and Mast Arms (4', 6', 8', 10', 12' & 15') to conform to I.E.S. recommendations.
- ✓ Continuous Tapered Octagon shafts from open hearth steel.
- ✓ Heavy steel construction for maximum strength.
- ✓ Detachable mast arms, brackets, and transformer bases for easy installation and maintenance.
- ✓ Ornamental scroll braces for beauty AND strength.
- ✓ Mechanical priming at factory with red oxide (inside and out) for longer life. Finish coat can be easily applied after standards are in place.
- ✓ Special designs to meet ANY and ALL special requirements. CONSULT THE KERRIGAN ENGINEERING DEPARTMENT.

WRITE NOW
(on your letterhead please)
for your
FREE COPY
of our Kerrigan Lighting Standard booklet AIA which gives you detailed specifications and catalog information.

— Write —
KERRIGAN IRON WORKS, Inc.
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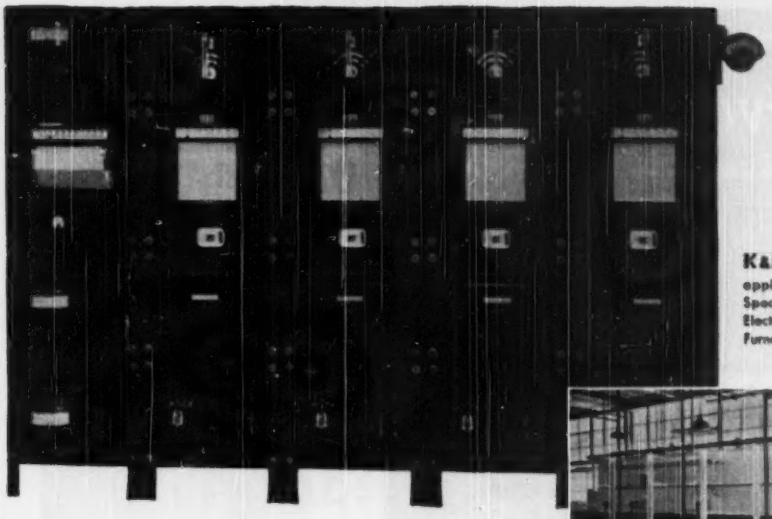
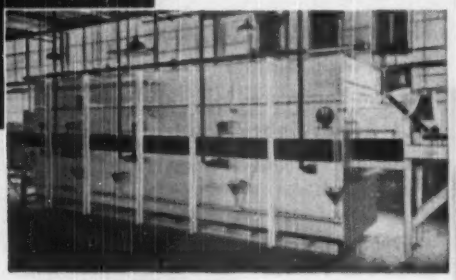
274 MADISON AVENUE, N. Y. C.



K&M EBONIZED ASBESTOS
applied to control mountings of the Special Atmosphere Roller Hearth Type Electric Furnace, made by The Electric Furnace Company, Salem, Ohio.



K&M EBONIZED ASBESTOS
FOR SAFE MOUNTINGS THAT STAY PUT

The Electric Furnace Company's Special Atmosphere Roller Hearth Type Furnace is modern high-efficiency equipment. Control panels must live up to the same standard. Therefore K&M Ebonized Asbestos was adopted. This advanced K&M electrical mounting material combines unusual dielectric strength, mechanical strength, compactness and shipshape finished appearance. These values endure because K&M Ebonized Asbestos resists shock, vibration and temperature effects.

In addition to lasting serviceability, K&M Ebonized Asbestos means simplified production and assembly. Time savings result from the easy handling and cutting; the quick, clean machining and drilling.

The all-around utility of K&M Ebonized Asbestos is based on the proved K&M composition of asbestos fiber and binding cement—pressure-molded to high density, and impregnated with special insulating compound. Thicknesses from $\frac{1}{8}$" to 4" are available, so that engineers and designers are readily able to make a wide range of applications—switchboard mountings—bus bar runs—compartment linings—test tables, bench boards and the like. Full details regarding any uses will be promptly sent on request. Write us.

Nature made Asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873

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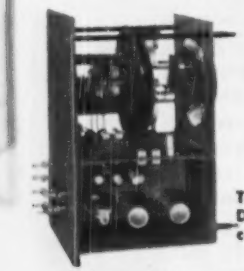
In Canada—ATLAS ASBESTOS CO., LTD., MONTREAL, TORONTO, WINNIPEG and VANCOUVER

Control Corporation's
Supervisory Control
PLUS TELEMETERING...
COMPLETES THE DISPATCHER'S PICTURE

Flexible SUPER-TROL* Combined with Telemetering Is Custom-Engineered to Handle ALL Supervisory Control Problems

*SUPER-TROL Is Control Corporation's Modern Method of Supervisory Control



Telemetering added to SUPER-TROL enables the modern Dispatcher to keep instant and continuous finger tip control over all equipment of his system.

Telemetering operates over the same line used for SUPER-TROL . . . requires no extra circuits . . . can handle supervisory, telemetering and telephone operations simultaneously.

SUPER-TROL installations easily incorporate voltage, power, flow and pressure and water level telemetering. Recording meters supply continuous, accurate performance records . . . fast, money-saving Telemetering.

Write for Bulletins AA-2 and EA-2 which explain Control Corporation's Supervisory Control and Telemetering System. It's the modern method of *complete* supervisory control.

CONTROL CORPORATION

gor (Maine) Hydro-Electric Co, superintendent of electrical power for St. Croix Paper Co, and manager of National Battery Co plants in New York and Zanesville. Rentner started with Line Material in 1923 as general foreman of the machine shop in the central plant in South Milwaukee, Wis.

•

Hartford Electric Light Elects Gibson as VP

Raymond A. Gibson has been elected a vice president of Hartford Electric Light Co with the retirement of Ralph D. Cutler after 42 years of service.

Gibson joined the Hartford utility's sales department in 1923. Later he

RAYMOND A. GIBSON

served as editor of the company's employee publication, "The Illuminator," as advertising manager, assistant commercial manager, and assistant to vice presidents. He was named sales manager in 1945.

Cutler, a member of the executive committee of the Association of Edison Illuminating Companies, has been a vice president since 1929. He joined the company in 1907 and was sales manager before his election as a vice president. Cutler will continue as a director.

•

Charles A. Dostal, vice president of Westinghouse Electric Corp since 1943, has retired after more than 43 years of service with the company. He has held a number of sales posts, among them Chicago district manager; regional manager in charge of the Pittsburgh, Chicago, and St. Louis appliance districts; and Pacific Coast district manager. He has received the Westinghouse Order of Merit.

Albert J. Maslin has been appointed assistant to the engineering manager of the transformer division of Westinghouse Electric Corp at Sharon, Pa. He will continue to head the general trans-

WILL THIS COAL FEED THE WRONG KIND OF FIRE?

Those giant coal piles that stand next to power plants present little fire hazard in themselves. But when industry feeds its coal into pulverizing machinery to make a faster-burning, more efficient fuel, then sends it through ducts connecting pulverizers to storage bins—the picture changes! The fine coal particles ignite easily, burn fiercely—and flames inside the duct are almost impossible to get at.

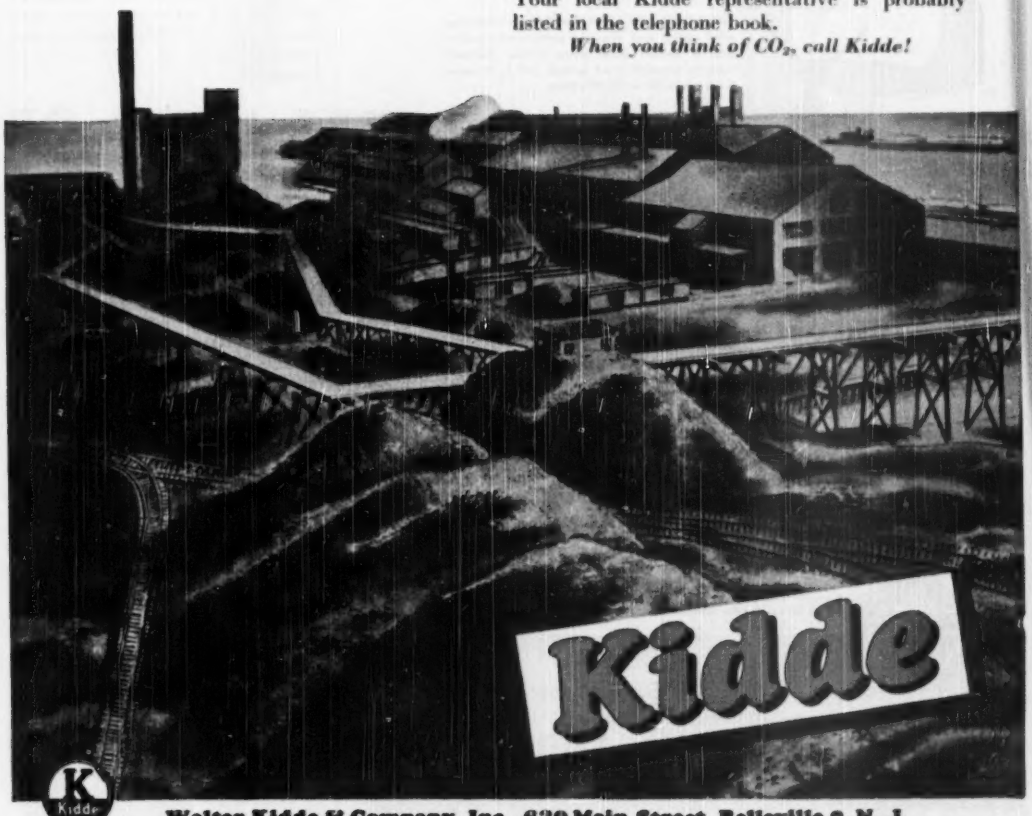
That hazard is taken care of in a mighty effective way at the East River Plant of Consolidated Edison Company of New York—by a *Kidde* automatic extinguishing system.

If a fire breaks out in the duct, the system goes into action fast. Pressure trips operate to close the duct dampers . . . flame-smothering carbon dioxide (CO_2) pours through *Kidde* Nozzles directly into the duct. The flames are out in a few seconds—*and the unburned coal stays dry, clean, ready for use.*

It's in cases like this—where hazards are toughest—that Kidde skill counts *most*. It will pay *you* to bring your fire-protection problems to us.

Your local Kidde representative is probably listed in the telephone book.

When you think of CO_2, call Kidde!



Walter Kidde & Company, Inc., 630 Main Street, Belleville 9, N. J.

In Canada: Walter Kidde & Company of Canada, Ltd., Montreal, P. Q.

Bendix-Friez INSTRUMENTS

for ANY Weather Condition!

AEROVANE® DIAL INDICATORS—Separate dial indicators for wind speed and wind direction now available in 4 inch, 6 inch, 8 inch, and 12 inch diameters. Dials in any color combination and with indirect lighting can be furnished.

HYGROTHERMOGRAPH—Temperature recorder for temperature and relative humidity—ideal for meteorological stations—particularly well adapted to the requirements of industry in general.

THE AEROVANE® TRANSMITTER—Combines wind speed and direction components in one unit. It consists of a three-bladed molded rotor to measure wind speed, and a streamlined vane for wind direction.

UNIVERSAL RECORDING RAIN GAGE—The universal Recording Rain and Snow Gage is designed and constructed to assure durability and long life under severe weather conditions. All forms of precipitation—rain, hail, sleet and snow—may be measured.

MAXIMUM-MINIMUM THERMOMETERS are in service at all meteorological and climatological stations to collect basic climatic data. Maximum and Minimum Thermometers provide an easy method for determining extremes of temperature over any period.

Whatever your needs for weather data, and wherever you need to collect them, BENDIX-FRIEZ makes the proper instrument for the purpose. Manufacturers of the world's finest meteorological instruments and principal supplier to the United States Weather Bureau for over 73 years. Prices and literature on request. ®REG. U. S. PAT. OFF.

FRIEZ INSTRUMENT DIVISION of Bendix AVIATION CORPORATION

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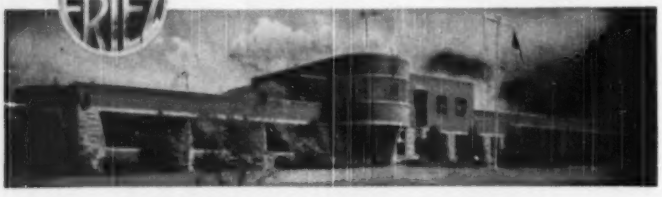


Source of the World's Finest Weather Instruments

former development section and also will be responsible for transformer insulation development and coordination of other engineering projects at the plant. Maslin joined Westinghouse in 1922. He was on the staff of J. F. Peters, consulting engineer for the company, and later became advisory engineer for the transformer division. He has been granted nine patents, mainly for transformer development.

•

A. O. Smith Names Floyd Executive Vice President

J. M. Floyd, vice president in charge of manufacturing for A. O. Smith Corp, has been named executive vice president of the company. He will take over general operating supervision under the general direction of the president.

Floyd has been in charge of manufacturing since he went to A. O. Smith in 1936 from Bendix Aviation Corp, South Bend, Ind. There he had been works manager of the Bendix products division.

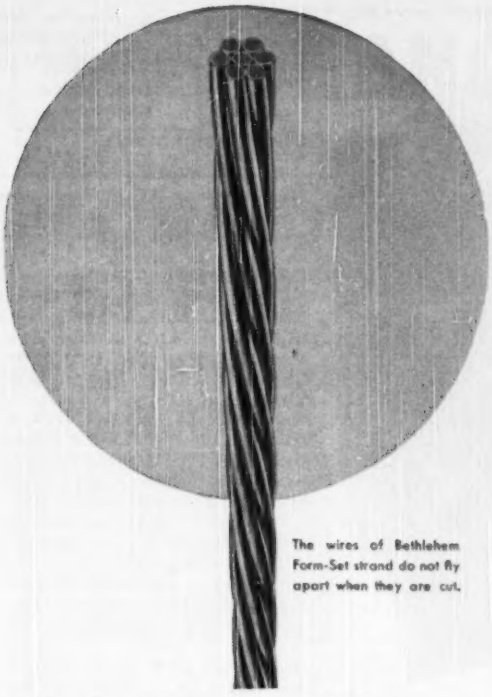
Floyd will continue as a member of the board of directors and the executive committee of A. O. Smith and as a vice president of A. O. Smith Corp of Texas.

•

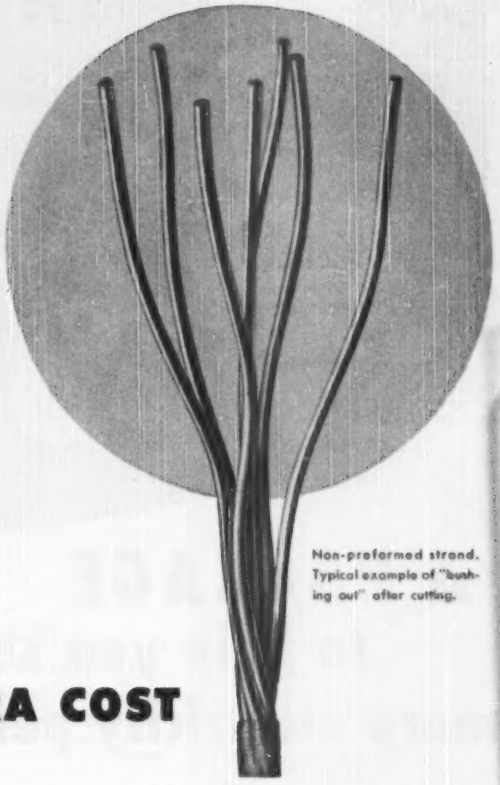
W. R. Weise, superintendent of planning and engineering in the electric distribution department of Cincinnati Gas & Electric Co since 1948, has been named assistant manager of the department. **H. W. Grate**, who has been superintendent of distribution engineering, will succeed Weise, and **J. A. Keller**, associate engineer in electric distribution, will take over Grate's duties. Weise and Keller have been with the company for about 25 years and Grate for 21 years.

Donald M. Quick has been appointed assistant to the chief engineer of the electric engineering department of Public Service Electric & Gas Co, Newark, N. J. Quick joined Public Service as a cadet engineer in 1923. In 1937 he was assigned to the electrical division of the electric engineering department, where he worked on design of generating stations and substations. He was made senior engineer in 1948.

J. Shirley Gracy, vice president and director of personnel of Florida Power Corp, has been named vice president in charge of division operations. **M. F. Bunnell**, assistant employment manager, has been appointed director of personnel to succeed Gracy. Gracy, who joined the company in 1927, organized the personnel department in 1937. Bunnell



The wires of Bethlehem Form-Set strand do not fly apart when they are cut.



Non-preformed strand. Typical example of "bushing out" after cutting.

SO MUCH EXTRA

FOR SO LITTLE EXTRA COST

That's one very good definition of Bethlehem's Form-Set strand. Form-Set is preformed and therefore has several advantages over the non-preformed type—yet you pay virtually no more for it. The slight additional charge is far more than offset by the extra values you get.

Form-Set is "gentle"; it has no inner tension. Preforming curbs wildness. Note, in the photographs, the difference between the Form-Set strand and the non-preformed sample. Both pieces have been cut; yet even without seizing, the wires of the Form-Set strand lie snugly in place. No bushing, no spraying in every direction.

This characteristic makes Form-Set easier to handle . . . easier to insert in fittings. Saves time, results in better work. The preformed construction is particularly helpful in the high-strength and extra-high-strength grades.

Widespread use in the field has proved these statements many times over. You yourself might like to know more about Form-Set; if so, ask a Bethlehem man to call. He'll tell you the full story.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Bethlehem *FORM-SET* Strand

started with Florida Power in 1926. After serving as district manager he joined the personnel department in 1944.

•

New Assignments

Hamilton Merrill, vice president of Manning, Maxwell & Moore, Inc, has been appointed vice president in charge of the Consolidated-Ashcroft-Hancock division of the company . . . **H. D. Middel** has been appointed manager of the mechanical divisions of General Electric Co at the Hanford works, Richland, Wash. He has been acting manager since last November. **H. D. Miller**, former manager, has been transferred to the staff of C. N. Gross, manager of the manufacturing divisions . . . **J. E. Templeton**, manager of the Los Angeles branch of P. R. Mallory & Co, Inc, Indianapolis, has been named manager of the company's wholesale division. . . . **Robert L. Sutton** has been appointed market development supervisor for the eastern district of Westinghouse Electric Corp . . . **Robert E. Rice** has been appointed sales manager of International Graphite & Electrode Corp, St. Marys, Pa. He formerly was assistant sales manager of its parent company, Speer Carbon Co . . . **Morley Fox** has been appointed supervisor of salary standards and employee services for British Columbia Electric Co, Vancouver. He succeeds **R. M. Bibbs**, who has been named assistant to the manager of transportation operations.

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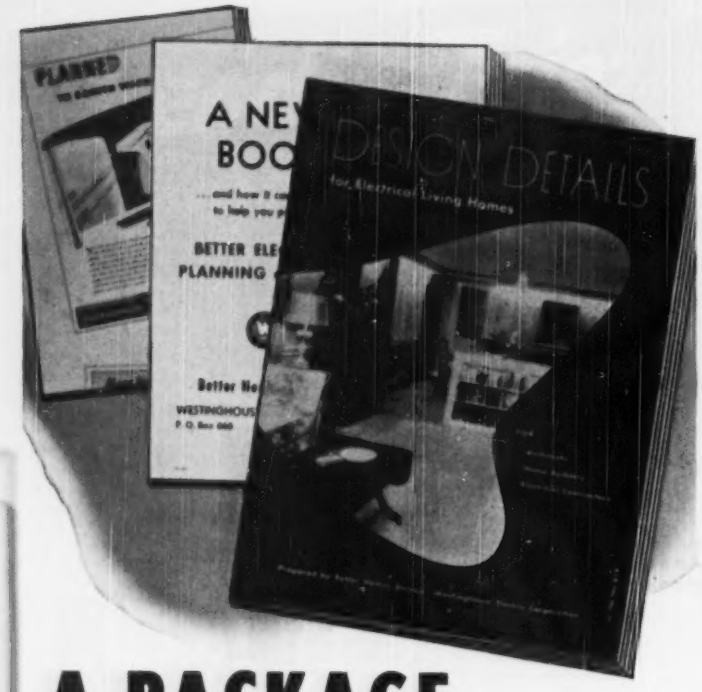
Robert M. Peabody has been named chief electrical engineer of the Metropolitan Water District of Southern California. He succeeds **James M. Gaylord**, who has reached retirement age. Peabody has been in the district's engineering organization since 1933 and has been first assistant to the chief electrical engineer for the past 17 years. At the time of his promotion he held the position of senior mechanical engineer. Gaylord has been chief electrical engineer of the water district since the position was created in 1930. Some of the duties which have been performed by Peabody will be taken over by **Edward W. Rockwell**, a senior electrical engineer.

OBITUARY

Harry E. Eaton, 52, Kentucky Utilities Co manager at Winchester, died at his home May 15 following a heart attack.

Frank Loughlin, 44, safety engineer with Landers, Frary & Clark, New Britain, Conn., died suddenly in New Britain May 18.



A PACKAGE
to help you sell more electricity per home

Here's an effective way to increase residential load . . . give architects and builders design details that make it easy for them to include in new or modernized homes the kind of electrical installation that will stimulate greater use of electricity.

To furnish this much-needed information, the Better Homes Bureau of Westinghouse has developed a new booklet . . . "Design Details For Electrical Living Homes". Some of the details included are cove, cornice, valance and pin-hole spotlighting; kitchen and laundry planning data; and wiring design. It's a book architects, builders and electrical contractors will find of practical value.

By providing the building industry with this know-how on modern planning techniques, you build a solid foundation for consumer promotions on better planned homes.

We have prepared a package of suggestions on how this booklet can be used to help you promote better electrical planning of homes, and examples of newspaper advertising built around the planning theme.

This package, together with a copy of the Design Details Book, will be sent you on request. The Design Details Book is available to utilities for local distribution at a special price of $7 per 100. Better Homes Bureau, Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pennsylvania. G-10111

YOU CAN BE SURE . . IF IT'S Westinghouse

BETTER HOMES BUREAU

ADVERTISEMENT

More Business—More Profit—for Contractors

NOCRETE
WITHOUT CONCRETE ENCASEMENT

ORANGEBURG
Fibre Conduit News

STANDARD
WITH CONCRETE ENCASEMENT

VOL. 1 NO. 3 JUNE 1950

MORE DESIGN ENGINEERS SPECIFY THIS CONDUIT

For One and Two-Duct Jobs—NOCRETE

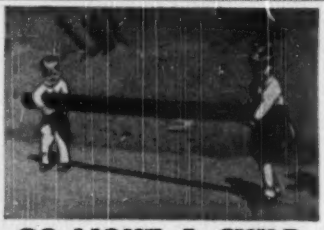
More contractors than ever appreciate the profit possibilities of NOCRETE for single or double duct runs. For when conditions favor its use, NOCRETE—installed *without* concrete encasement—*saves time, work* and *money*—in such installations as factories, schools, colleges, hospitals, drive-in theaters, power, telephone and other communications systems . . . also service entrances, parkway and suburban lighting, airport lighting and communication.

Easily Tooled on the Job

Orangeburg can be worked right in the field. It is easily tooled and can be sawed to any length. It saves time, makes work lighter for the crew. Contractors save by its use, make better net profit.

57 Years' Record of Success

Orangeburg started in 1893. Its quality and durability are *proved*. Today it is standard practice for public utilities, municipalities and industry to use Orangeburg Fibre Conduit when installing cables underground. Orangeburg is leader and first choice in every city and state.



SO LIGHT A CHILD CAN CARRY IT

Standard 4" weighs only two pounds per foot and even *Nocrete* with its heavier wall weighs but four pounds per foot in the 4" size. Think what this lighter weight means. It means lower transportation and handling costs, speedier installation.

ORANGEBURG'S OUTSTANDING ADVANTAGES

These advantages have met with wide acceptance. Each year finds more and more contractors, design engineers, utilities and municipalities turning to Orangeburg for the permanent and economical installation of electrical services underground.

1. Will not corrode. Lasts indefinitely.
2. Impermeable wall and tight joints prevent corrosive ground waters from entering.
3. Lays faster and at lower cost than any other type of conduit.
4. Low coefficient of friction keeps pulling tensions on cable to minimum.
5. Protects cable sheath from abrasion when pulled in—also from wear during cable movement resulting from alternate expansion and contraction with changing loads.
6. Resists acids, alkalis, salt, grease, oil.
7. Light, easy to handle and tool on the job.
8. Tough, resilient—will not crack or break when properly handled.

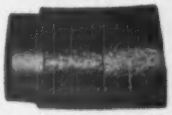
TAPERED SLEEVE JOINTS PREVENT INFILTRATION

. . . of corrosive ground waters. Easily assembled, with Tapered Sleeve Couplings, these joints are permanently watertight.

For Multiple Duct Jobs—STANDARD

ORANGEBURG STANDARD — installed *with* concrete encasement—is the economical construction where duct banks of three or more ducts are involved. In *all* installations, from single to multiple, Orangeburg lays faster, at lower cost, than any other type of conduit.

NOW BRANDED WITH
ORANGEBURG
TRADEMARK



Send for Free Bend Section Folder

Illustrated folder—showing various types of Orangeburg Bend Sections and Angle Couplings—sent FREE on request. Write today to Dept. EW-6, Orangeburg Manufacturing Co., Inc., Orangeburg, N. Y.

ORANGEBURG MANUFACTURING CO., INC., ORANGEBURG, NEW YORK

Graybar ELECTRIC COMPANY

DISTRIBUTORS, ORANGEBURG FIBRE CONDUIT

GENERAL ELECTRIC SUPPLY CORPORATION

MANUFACTURERS and MARKETS

English Electric Buys Control of Canadian Firm

(McGraw-Hill World News)

English Electric Co, Ltd, is buying its way back into the Canadian picture.

English Electric, one of Britain's big electrical manufacturers, has bought a controlling interest in John Inglis Co, Ltd, Toronto, for about $2.1 million. John Inglis makes heavy engineering equipment and a variety of consumer appliances. It also owns a former English Electric subsidiary, English Electric Co of Canada, Ltd, which makes electrical plant at St. Catherine's, Ontario.

Major J. E. Hahn will remain as president of John Inglis.

English Electric already has factories in South Africa and Australia. The Canadian purchase represents its approach to greater dollar earnings.

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Insulating Materials Sales Index Up for February

Sales of electrical insulating materials for February rose 3% from the January level.

The index of sales billed, compiled by the National Electrical Manufacturers Association, was 356 in February, compared to 345 in January. February sales were 8% above the same month of 1949, when the index read 329.

SEE-ABILITY ADVANTAGE of modern pendant type of street lighting luminaires over old upright variety is illustrated by miniature perspective roadway in street lighting schools now being presented across the country by Westinghouse Electric Corp's Lighting Division. E. B. Karns, divisional manager of lighting sales, (above) looks at results produced on road by pendant-shielded lighting. Model also is used to demonstrate proper spacing of luminaires and specularity and reflection factor of various road materials

Line Material Co Moves into New Office Building

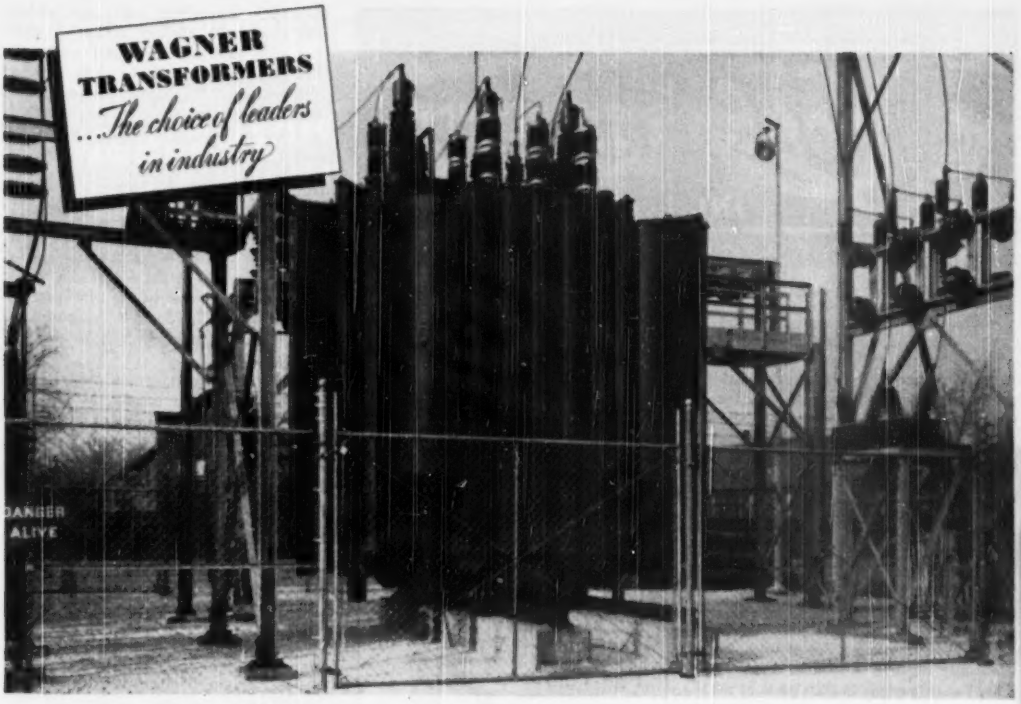
Line Material Co, now a division of McGraw Electric Co, has moved into a new $500,000 office building at 700 W. Michigan St, Milwaukee. The two-story building contains 45,000 sq ft of floor space, twice as much as the company's previous quarters, and two more stories can be added if necessary. Non-glare light sources in continuous 70-ft rows provide 50 ft-c of light.

The four-story building attached to the west side of the new office, purchased from Campbell Laundry Co about a year and a half ago, is being remodeled and prepared for light assembly and manufacturing of protective equipment. These operations will be moved in about the middle of June from Line Material's central plant at South Milwaukee, Wis.

MANUFACTURING BRIEFS

McCabe-Powers Auto Body Co, St. Louis, has purchased American Coach & Body Co, Cleveland manufacturer of automotive equipment for public utilities. The public utility division of McCabe-Powers now will be known as the Powers-American division.

A new three-year $23.6-million plant improvement program is planned by Allegheny Ludlum Steel Corp. Principal need for the new program, which is in addition to the $30-million, five-year expansion now being completed, is to keep the company in step with changing and increasing demands for high alloy and electrical steels. The improvements will integrate operations, supplement the new electric furnace melting



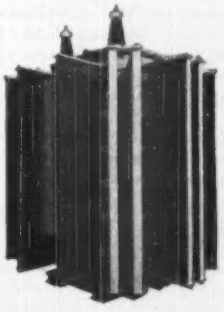
Wagner Transformers provide Carnegie-Illinois Steel dependable distribution of power to *"keep 'em rolling"*

When you think of the Carnegie-Illinois Steel Corporation, you may have a mental picture of the greatness of American industry. It *is* great—a modern goliath of industrial production—rolling out the steel that is the sinew of all industry. And its greatness is in *production.*

Production is a word with which Wagner Transformers like to be associated. Hundreds and hundreds of Wagner power transformers, of all types and sizes are distributing power to industrial plants throughout the country. In every case they are adding to their reputation for complete dependability . . . for unfailing service . . . that prompted Carnegie-Illinois to install Wagner Transformers.

Wagner engineers are qualified to specify the correct transformer for *your* requirements. Nationwide service facilities are available to users of Wagner Transformers. Consult the nearest of our 31 branch offices or write us.

Shown below is a Wagner 16,667 kva Power Transformer. Single phase, 60 cycle, 72,000 to 6,600 volts. This transformer was adapted to the special needs of the Carnegie-Illinois application. Wagner engineers can suit your special requirements as well.



WAGNER ELECTRIC CORPORATION
6456 Plymouth Ave., St. Louis 14, Mo., U.S.A.

Wagner Electric Corporation
EST. 1891

ELECTRIC MOTORS - TRANSFORMERS - INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS - AIR AND HYDRAULIC

BRANCHES IN 31 PRINCIPAL CITIES

THE T. J. Cope INC. REPORTER

Written by Edgar W. Baird, Jr., President, T. J. Cope, Inc., 711 S. 50th St., Phila. 43, Pa.

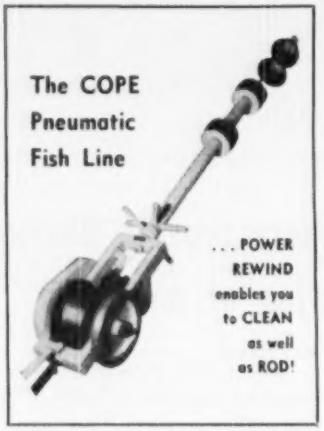
You, I'm sure, will agree with me that our high standard of living—our greatest progress—the largest savings in time, labor and money—are all the result of the invention of machinery. That's why all of us are ever on the lookout for mechanical devices to replace laborious hand methods. That's why COPE developed the Pneumatic Fish Line!

In fact, the savings our Fish Line produced far surpassed our expectations. I could dwell at considerable length on customers' praise for this equipment. One company saves 58 minutes out of each hour previously required in rodding ducts. Another reports savings in costs up to 97%. I think you'll agree with me that such a device deserves the careful consideration of every one wanting to do the best possible job at the lowest cost. It's the old story you and I have repeatedly heard of low machine costs compared to high manual costs. And with business becoming more and more competitive, those of you who are contractors cannot afford to be without the COPE Pneumatic Fish Line to do the job.

You'll be interested in learning about the major improvements we made in our Fish Line since we first developed the Model "H" a few years ago. That model requires re-reeling by hand. Our latest Model "A" with air turbine provides the unique feature of a wholly power-operated reel. It makes possible the attachment of cleaning tools and the winch-line for pulling in cable. As a result, not only laborious hand re-reeling has been eliminated but substantial savings have been effected.

But, in addition to all the above advantages, I want to point out to you that the COPE Pneumatic Fish Line does even more. It makes possible the laying of long lines of conduit. Runs as long as 3,000 feet and ducts as large as eight inches in diameter have been rodded in a matter of minutes! In fact, one large cable manufacturer has not only purchased several units but recommends our machine to its customers.

Why not let our Fish Line work for you too and save you money? COPE's constant objective is saving customers' dollars by furnishing labor saving devices and high quality products—whether they be our Fish Line, Cable Trough, Street Lighting Brackets



or any of our miscellaneous items such as Cable Feeders, Manhole Guards, Warning Signs, Aerial and Ground Tents, etc. Complete descriptions can be found in our new Catalog #83 and Bulletins—yours for the asking. If you haven't copies, write us today, won't you?

I am,

As always,

E. W. Baird Jr.

President

T. J. COPE, Inc.

711 S. 50 St. Philadelphia, Pa.

facilities and rolling mills, and widen the company's product range. A new hot strip mill and additional cold rolling facilities will be added at the Brackenridge, Pa., plant, and additional cold rolling equipment will be installed at the neighboring West Leachburg plant.

More than 6.5 million lb more primary aluminum was produced in the United States in the first quarter of 1950 than in the first quarter of 1949, according to figures reported by the Aluminum Association. Production in the first quarter of 1950 was 322,425,008 lb compared to 315,913,849 lb in 1949.

Dealers are being offered a special Electric Fan Sales-Aid Kit by the Electric Fan Section of the National Electrical Manufacturers Association. Designed as a text book for the training of salesmen on electric fans and their use, the kit includes two copies of the section's new 16-page manual, *Fans for Year 'Round Comfort* and 50 copies of a four-page consumer folder, *Electric Fans for Your Comfort*.

A. O. Smith Corp will expand its motor manufacturing facilities at Tipp City, Ohio, to include three-phase power units as well as single-phase motors. A new 60,000-sq-ft, $500,000 factory will be constructed this summer at the recently acquired Whirl-A-Way Motors, Inc. plant. Number of employees at the plant, now about 125, is expected to reach 400.

Manufacturing activities of American Magnesium Corp, the magnesium fabricating subsidiary of Aluminum Co of America, have been assumed by Alcoa, and American Magnesium has become inactive.

Radio Corp of America has bought a new building to provide an additional 126,000 sq ft of space for expansion of electron tube manufacturing facilities at its Harrison, N. J., plant.

Availability of porcelain enameled tanks for distribution transformers 10 through 25 kva has been announced by Kuhlman Electric Co, Bay City, Mich. The tanks are backed by a lifetime guarantee against corrosion.

Metals Prices
May 29, 1950

COPPER, Conn. V., lb	$ .20½
LEAD, N. Y., lb	.12
ZINC, prime Western, E St. Louis, lb	.12½
TIN, Straits qual, N. Y. lb	.78⅛
ALUMINUM, base price	.17½
NICKEL, base price	.40
STEEL billets, Pitts., ton	53.00
STEEL scrap, No. 1 heavy, Pitts., ton	38.00

In Plant After Plant—

One of America's Largest Auto Manufacturers Has Selected MULTICLONES for Fly Ash Recovery!

Over 35 MULTICLONE Units To Date in Various Plant Divisions!

A Few of *Many* MULTICLONE Advantages!

POINT 1 —It Saves Space!

Plant space costs money. Because the Multiclone makes *really important* savings in space, it makes similar savings in plant costs. The chart tells only part of the story because, in addition to being far more compact both in square and cubic footage, the shape of the Multiclone can be adjusted to fit various space requirements—either long and narrow, short and wide, or square. You can often fit the Multiclone into tight spaces or waste areas too small for other equipment!

Make	Relative Space Requirements In Sq. Ft.	In Cu. Ft.
Multiclone	1.0	1.0
Collector A	2.1	1.8
Collector B	5.9	3.2
Collector C	6.8	3.9

POINT 2 —It Recovers the "Fines"!

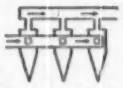
Because its exclusive vane design and small diameter tubes generate higher centrifugal forces, the Multiclone recovers a large percentage of even the very fine particles 10 microns and less as well as the heavier particles. Multiclone's high recovery of both small and large particles means high overall collecting efficiency.

POINT 3 —It is Unusually Adaptable!

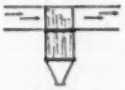
In addition to the shape adaptability outlined above, Multiclone's inlet-outlet connections are also readily adaptable to plant restrictions. Where headroom is low, install the Multiclone with side-inlet, side-outlet. Where side clearances are small, use side-inlet, top-outlet arrangement. Or still other arrangements are possible!

POINT 4 —It is Simple!

Both installation and maintenance of the Multiclone are unusually simple. For example, the Multiclone requires only a single inlet and a single outlet duct compared with the complicated multiple ducts of conventional cyclones. This not only saves space—but is simpler and cheaper to install and insulate. Moreover, the Multiclone has no filters to replace, no high-speed moving parts to maintain, nothing to require frequent cleaning or repair . . . and a single collecting hopper serves many tubes!



Conventional Cyclone



Multiclone

POINT 5 —Still Other Advantages!

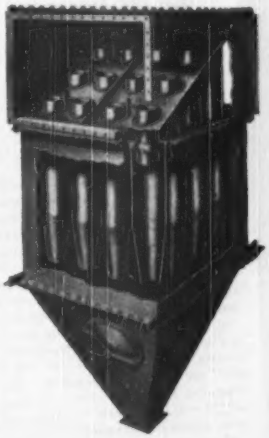
The above advantages are by no means the complete story on Multiclone savings. Get *all* the facts before you decide on any recovery installation.

Send for this Multiclone booklet!

COTTRELL PRECIPITATORS · MULTICLONE COLLECTORS · TURBULAIRE SPRAY DRYERS

YEAR AFTER YEAR—in plant after plant—one of the nation's largest automobile manufacturers has selected Multiclone Collectors for recovering fly ash and dust in its many manufacturing divisions. This repeated selection of Multiclones—now totalling over 35 units—is high testimony to the many vital advantages found in Multiclone equipment. Check over some of these advantages as outlined at left . . . advantages that will save space—cut installation costs—boost recovery efficiencies—minimize maintenance and make other important savings on *your* recovery operations, too.

Then consider this fact . . . Any *one* of these advantages is sufficiently important in itself to make Multiclone equipment the logical choice for your recovery operations. But when you realize that the Multiclone offers definite, clear-cut advantages on *every* qualification essential to maximum efficiency and economy in recovery operations you have some idea of the far-reaching savings you will make by installing Multiclone.



Let us give you further information on Multiclone recovery equipment. A letter, wire or phone call to our nearest office places the information in your hands without obligation. Get *all* the facts—and you'll get Multiclone!

WESTERN Precipitation CORPORATION

ENGINEERS, DESIGNERS & MANUFACTURERS OF EQUIPMENT FOR COLLECTION OF SUSPENDED MATERIALS FROM GASES & LIQUIDS

Main Offices: 1004 WEST NINTH STREET, LOS ANGELES 15, CALIFORNIA
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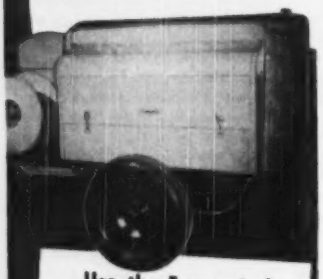
PRECIPITATION CO. OF CANADA, LTD., DOMINION SQ. BLDG., MONTREAL

Bring Compressor Costs Down!



Use the Economical

SMITH 105-P Compressor

The new Smith 105-P will handle the majority of your compressor jobs, for less. Powered with Chrysler's newest and largest industrial engine—Ind. 15, six cylinders, 4" bore, 5" stroke, 377 cu. in., 3" crankshaft, 7 main bearings, sodium cooled valves and Stellite valve seats for extra heavy duty and long life. Compressor valves are stainless steel disc type with Manganese Bronze seats. Delivers 105 cubic feet per minute. Equipped with improved type pilot valve and simplified control for efficient, long life with minimum attention.

Write for literature and prices.

Also write for information on
The New SMITH
MODEL 70-P COMPRESSOR

SMITH Air Compressors

Gordon Smith & Co. Bowling Green, Ky.

482 COLLEGE STREET

NEW ELECTRICAL CONSTRUCTION

NEW ELECTRICAL construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is included

UTILITIES

Proposed Construction

Arizona—Bureau Reclamation, Dpt., Interior, Phoenix, circuit breakers disconnecting switches and interrupter switch for ED 5 sub-station, Davis Dam Proj., near Phoenix, Spec. R3-PX—22 (Region 3). L. N. McClellan, Bldg. 1-A, Denver Federal Center, Denver, Colo., ch. engr.

Arkansas—Southwestern Power Admin., P.O. Box 1614, Tulsa, 1, Okla., 11 mi. 154 kv electric transmission line from Flippin to Bull Shoals Dam, Baxter Co. $100,000. Plans deposit $15.

Colorado, Wyoming and Nebraska—Bureau Reclamation, Dpt. Interior, Bldg. 1-A, Denver Federal Center, Denver, Colo., furnishing, and Cheyenne, Wyo., Gering, Neb., Greely, Loveland, Kremmling and Granby, Colo., controlling station supervisory control and selective telemetering switchboard and equip., etc. for Seminoe, Kortes, Guernsey, Boysen, Green Mountain and Estes Power Plants, Sidney, Greeley, Alcova, Cheyenne, Gering, Levner Dillon substations, Granby Pumping Plant and Flatiron dispatching office for the Missouri River Basin Kendrick, Colorado—Big Thompson and North Platte Projs. Spec. 2050. L. N. McClellan, ch. engr.

Fla., Jacksonville—City, City Hall, switchgear for city electric power distr. sys.; six-three phase volt type network units for city electric distr. sys. Utilities Engineer-Manager, Utilities Bldg., Zone 2, engr.

Idaho—Salmon River Electric Co-operative, Challes, 261 mi. rural distr. lines, 51 mi. transmission line and sys. imprvs. **$915,000.**

Montana—U. S. Eng., Fort Peck, constr. 69 kv outdoor sub-station and switchyard, 4,160 volt Master Unit sub-station, incl. control and protective facilities, relocating 15,400 kva reactor, Power Plant, Fort Peck east end of Ft. Peck Dam, approx. 20 mi. S.E. of Glasgow, CIVENG 24-016-50-59.

Nebraska—Bureau Reclamation, Dpt. Interior, Casper, Wyo., constructing Sidney sub-station, Transmission Div., Missouri River Basin Proj. approx. 1 mi. north of Sidney, Spec. No. 3048.

Neb., Broken Bow—City, Broken Bow, power plant addn. and generating equip. **$223,465.** L. E. Clark, supt. Utilities, Broken Bow.

N. J., Trenton—Bureau Yards & Docks, Navy Dpt., Arlington, Va., exhaustic wing and two pump houses, Air Turbine Laboratory. $3,000,000. Frank Grad & Son, 187 Market St., Newark, archts.

N. M., Los Alamos—U. S. Atomic Energy Comn., Los Alamos, buildings facilities, Inv. No. 291-50-89. Phase A, $1,500,000-$2,500,000; Phase B, $1,000,000-$1,500,000. Plans deposit $100.

N. Y., Astoria—Consolidated Edison Co. of New York, 4 Irving Pl., New York, Zone 3, steam electric generating plant near present plant. **$25,000,000.**

North Dakota—Bureau Reclamation, Dpt. Interior, Bismarck, construct Garrison - Washburn - Bismarck 230 - kilovolt transmission line, Missouri River Basin Proj., Spec. 2046.

Oklahoma—U. S. Eng., P. O. Box 61, Tulsa, 15-kv. switchgear for 2 generators; one set generator neutral equip., one lot of spare parts and accessories; services of one supervising erector, to be installed in powerhouse at Fort Gibson Dam, on Grand (Neosho) River, Wagoner and Cherokee Counties, approx. 5 mi. north of Fort Gibson, Inv. No. CIVENG 34-066-50-140.

Oklahoma—Cookson Hills Electric Co-operative, Stigler, 19.25 mi. 69 kv. transmission line, 3.25 mi. tie lines and sub-station, and 435.5 mi. rural distr. lines, Haskell Co. **$1,000,000.**

Pa., Polk—General State Auth., 18 and Herr Sts., Harrisburg, reconstruct electrical svs. at Polk State School. $505,630 Plans deposit $10. Harry R. Joyce, 616 Commerce Bldg., Erie, engr.

A DEPENDABLE SUPPLY — General Ceramics offers a reliable supply of uniformly high quality wet process porcelain electrical insulators. Competent engineering cooperation is always available to help work out your designs.

Available in Wet Process Porcelain or Steatite, Metallized if Needed

Use General Ceramics Wet Process Steatite for extra mechanical strength. Can be tapped without metal inserts. Also obtainable metallized to specification. ESTIMATES WITHOUT OBLIGATION.

General CERAMICS and STEATITE CORP.
KEASBEY • NEW JERSEY

Makers of Steatite, Titanates, Zircon Porcelain, Alumina, Light Duty Refractories, Chemical Stoneware, Lava, Graphite, Ferrites, Coaxial Cable

Save time and money with

G&W SPLICING KITS

G&W ELECTRIC SPECIALTY CO.

UNIT PACKAGES *for better cable joints*

Kits include each necessary item of material in the correct grade and proper quantity for making a cable joint of our standard design (or your own design or special type).

Advantages of Using G & W Splicing Kits —

- Each item is supplied in the correct quantity for a properly designed joint.
- Time and expense of securing various items from different sources is saved.
- Accumulation of dead stock is avoided. No waste.
- All materials are kept clean and ready for use.
- Each Unit Splicing Kit is labeled for easy identification.

G&W ELECTRIC SPECIALTY CO.
7786 Dante Ave. Chicago 19, Ill.
Representatives in principal cities

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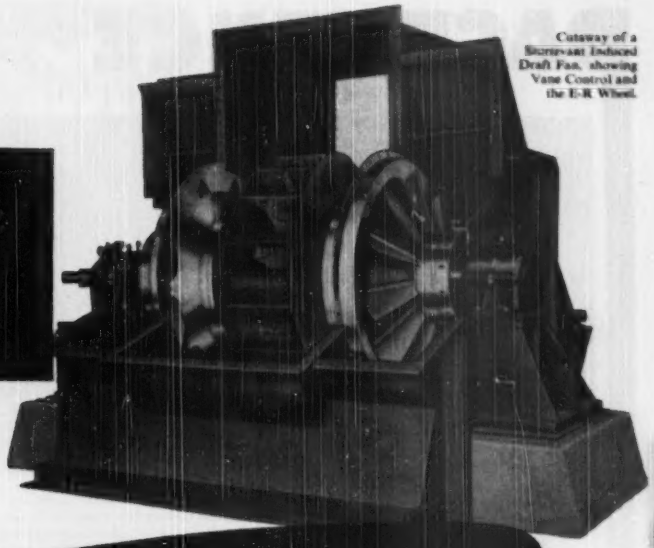
FANS



Cutaway of a Sturtevant Induced Draft Fan, showing Vane Control and the E-R Wheel.

...chosen for Philip Sporn Station

The new Philip Sporn Station at New Haven, West Virginia, is equipped with Sturtevant Fans for forced draft, induced draft and hot gas recirculation.

The Sturtevant Vane Control forced and induced draft units regulate exact pressure and volume output at a great saving in power. The induced draft Vane Control illustrated here shows how the entire mechanism is shielded from the dust-laden gas stream and exposed to access from the outside. Additional features have been included for this "pressurized" system.

Induced draft fans in the Philip Sporn Station are equipped with the E-R (Erosion-Resisting) Wheel, a feature first installed at other American Gas & Electric Company stations several years ago. It has proved its "ability to take it," even though bombarded with thousands of tons of abrasive fly ash.

For nearly 90 years, the name Sturtevant has meant efficiency and dependability to the power industry. For complete information on mechanical draft equipment, write to Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Mass.

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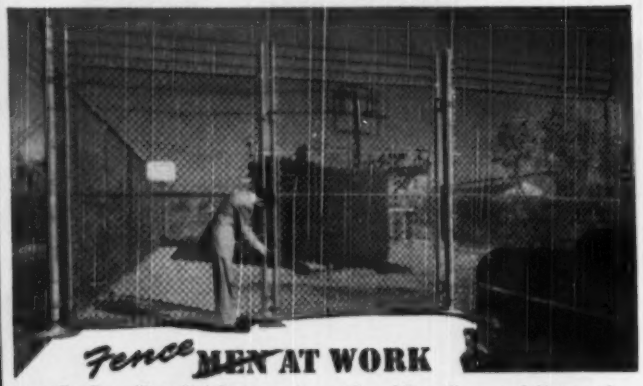

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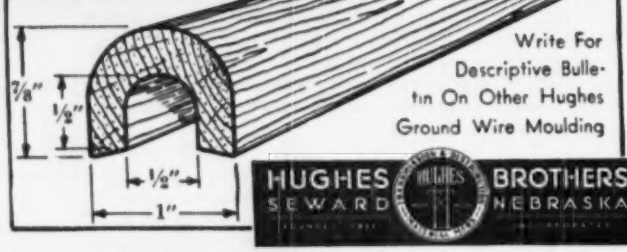

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South Carolina—Marion Electric Co-operative, Marion, 0.5 mi. rural distr. lines, 9.02 mi. conversion and one steel structure 22/7.2/12.5 kv. sub-station Marion and Dillon Counties. Bid date changed. J. B. McCrary Engr. Corp., 22 Marietta St. Bldg., Atlanta, Ga., engrs.

South Dakota—Upper Grand River Electric Assoc. Inc., Bison, 232.5 mi. rural distr. lines Perkins Co. **$233,000.** Scott Eng. Co., Inc., 711 Ninth Ave. S. W., Watertown, engrs.

Washington—Public Utility Dist. 1, Port Angeles, hydro-generating plant and sys. imprvs., Clallam Co. **$545,000.**

Wyo., Sheridan—Veterans Admin., Vermont Ave. between H and I Sts. N. W., Wash., 25, D. C., outside electrical distr. sys. alterations, incl. Electric Switch House 106, Spec. 5088, Proj. 13-4017.

Low Bidders & Contracts Awarded

California—Bureau Reclamation, Dpt. Interior, Elverta, foundations and steel towers 230-kilovolt transmission lines Shasta-Tracy 1 and 2, Rio Vista-Tracy Section, Central Valley Proj., Spec. 2575, from Duncanson-Harrelson Co., 520 West Cutting Blvd., Richmond, **$313,563**; stringing wires, etc. for Sacramento and San Joaquin River crossings, from Abbett Electric Co., 472 Tehama St., San Francisco, **$112,677.**

Illinois—U. S. Eng., 808 U. S. Court House & Custom House, 1114 Market St., Zone 1, May 16, rein.-con., brick, Alton Pump Station with electrically driven pump units and adjacent levee sections and gravity drainage structure, etc. in Wood River Drainage and Levee Dist., near Alton, Madison Co., Proj. Item II-C, CIVENG 23-065-50-90, from Midland Constr. Inc., 22 West Adams St., Chicago, **$318,872.** Est. 392, 626.

Mo., St. Louis—Union Electric Co. of Missouri, 315 N. 12 Blvd., Zone 1, 2 story, bsmnt., brick, rein.-con. service warehouse, and office bldg., Gratiot St. westward from 18 St., to Woermann Constr. Co., 3800 West Pine Blvd., **$2,000,000.** Bids 4/26.

Oregon—U. S. Eng., Pittock Block Portland, construct and model test 26,500 hp. turbine for Big Cliff dam, Marion Co., from Baldwin Locomotive Wks., Chester Park and Simpson St., Eddystone, Phila., Pa., **$415,370.**

Pa., West Mifflin—Westinghouse Electric Corp., Lebanon Church Rd., 1 story, 50x70 ft., brick, concrete block, steel frame atomic plant addn., concrete slab floor and roof constr. to Ragner Bennen Co., Investment Bldg., Pittsburgh, **$87,500.**

Washington—U. S. Eng., 4735 E. Marginal Way, Seattle, Zone 4, four generators for Chief Joseph Dam, Bridgeport, CIVENG 50-51, to Westinghouse Electric Corp., 3451 E. Marginal Way, Seattle, **$4,277,100.** Bids 4/18.

INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

Conn., New Haven—Yale University, New Haven, administration bldg., **$1,200,000**; anthropology museum, laboratory and teaching center **$5,000,000**; completion of art gallery, **$1,500,000**; chemical engineering bldg., **$2,325,000**; altering 10 bldgs. alterations, **$650,000**; repairs to Connecticut Hall, **$325,000**; new wing for Dunham Laboratory of Electrical Engineering, **$1,000,000**; completing Sage Hall of Forestry School, **$500,000**; Freshman Social Center, **$600,000**; new bldg. for geology bldg., **$1,000,000**; new physics bldg., **$3,500,000**; housing for students in professional schools, **$300,000**; Peabody Museum addn. **$400,000.**

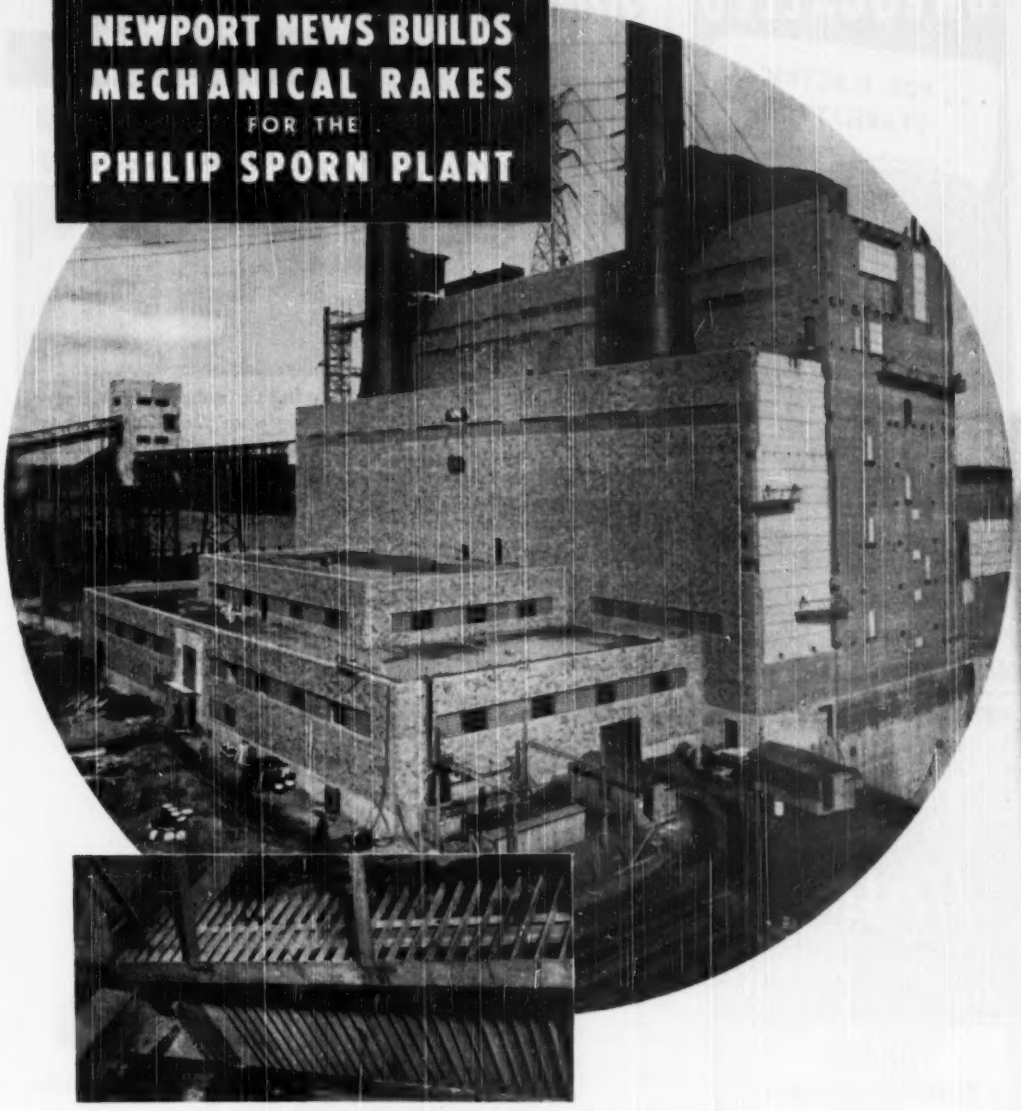
Kan., Kansas City—Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago, Ill., rein.-con., brick, steel, scale mfg. plant on 40 acre tract adjacent to Santa Fe R. R. Yards, at Turner, **$5,000,000.**

Low Bidders & Contracts Awarded

Fla., Palatka—Hudson Pulp & Paper Corp., Palatka, pulp and kraft paper plant exten. Owner builds, **$10,000,000.** Bids 5/9 awarded 5/13.

Pa., Pittsburgh—Jones & Laughlin Steel Corp. 3 and Ross Sts., general contract 6 furnace open hearth steel plant, South Side to Swindell Dressler Corp., Aspinwall, foundation to Morrison-Knudsen Co., Box 450, Boise, Idaho. Total est. cost **$17,000,000.**

NEWPORT NEWS BUILDS MECHANICAL RAKES FOR THE PHILIP SPORN PLANT



Two Newport News 7-foot mechanical rack rakes are installed in separate units of the Philip Sporn Plant of the American Gas and Electric Company. These standard small type rakes are equipped with electric controls. A traveling carriage makes each of the rakes available for the cleaning of many bays of racks. By use of the mechanical rakes a former major hand operation is reduced to one of minor periodic power activity.

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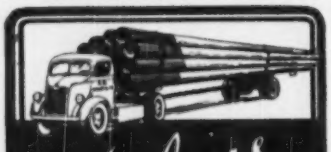

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CATALOGS • BULLETINS

● MOTOR STARTER: Catalog 1072 describes new 2,300-4,600-v motor starters for Class I, Group D hazardous locations. It is a combination-type starter with oil disconnect switch. The Electric Controller & Mfg Co, 2700 E. 79th St, Cleveland 40, Ohio.

● CABLE: Simplex-Anhydrex insulated cables for 0-2,000-v working range are presented with qualitative and quantitative information. Aerial, underground, and control cable are included. Simplex Wire & Cable Co, 79 Sidney St, Cambridge 39, Mass.

● CERAMICS: Electrical and mechanical properties of AlSiMag custom-made technical ceramics appear in a selection chart, No. 501. American Lava Corp, Chattanooga 5, Tenn.

● PRECIPITATORS: Electrostatic precipitation is explained along with case histories of typical installations in 16-page Bulletin GEA-5212. General Electric Co, Schenectady 5, N. Y.

● POWERHOUSE CRANES: Pictorial, two-color Bulletin 73, "How Whiting Cranes are Serving the Utilities" illustrates the variety of cranes built by the company. Whiting Corp, Harvey, Ill.

● INSTRUMENTATION: "Advanced Instrumentation for Steam-Operated Generating Stations," Bulletin 90-1, features information on Electronik potentiometers; pneumatic transmission, pressure gages, thermocouples are included. Minneapolis-Honeywell Regulator Co, Brown Instruemnts Div, Wayne & Windrim Ave, Philadelphia 44, Pa.

● GAS-FILLED CABLE: A discussion on operation, application, and performance of low, medium and high-pressure gas-filled cable appears in "Gas-Filled Cables." Construction Materials Advertising Div, General Electric Co, Bridgeport 2, Conn.

● ENCLOSURES: Many types of control desks and panels, instrument panels, and switchgear housings are illustrated in Bulletin EE. The Kirk & Blum Mfg Co, Cincinnati 25, Ohio.

● LIGHTING: "A Planning-Guide to Improved Plant Lighting" covers economics, planning, and equipment selection. Benjamin Electric Mfg Co, Des Plaines, Ill.

● TRANSFORMERS, OCB'S: "ACP Distribution Transformers", Bulletin 61B7309A, gives mechanical and other data for ACP transformers, 3 through 100 kva. Another bulletin, 71B6093C, contains information on Types OZ-110 and OZ-210 oil circuit breakers. Allis-Chalmers Mfg Co, 932 S. 70th St, Milwaukee, Wis.

● TRANSFORMERS: Many photographs illustrate Niagara oil-immersed self-cooled power transformers and a dry air blast transformer. Erie Electric Co, Inc, 120 Church St, Buffalo, N. Y.

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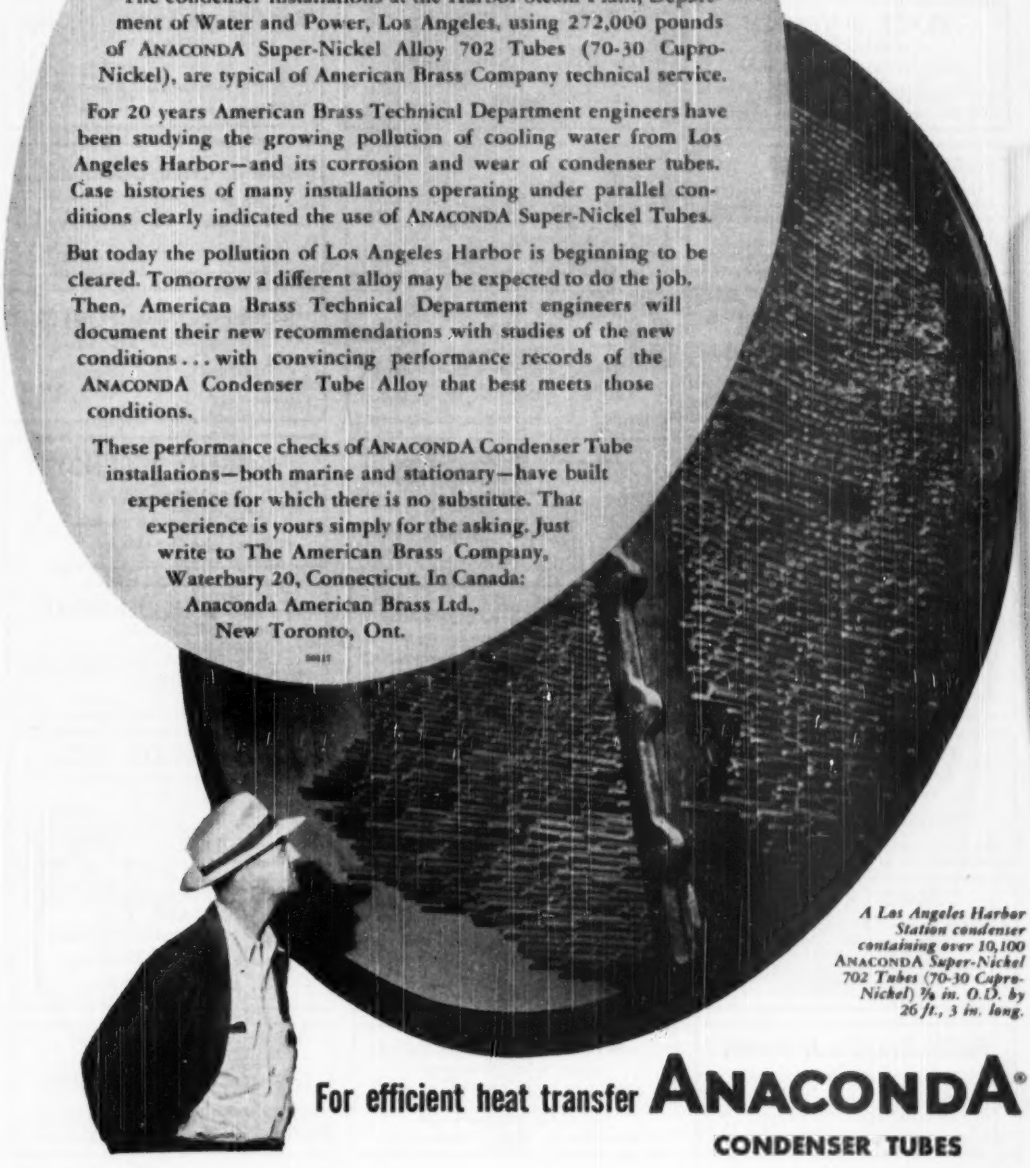

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BOOK REVIEWS

The Theory and Design of Inductance Coils. By V. G. Welsby. Published by Macdonald & Co, London (E.C.4). 180 pages, illustrated. Price 18 sh.

Formulas for coils are stated and derived. Frequent graphs present the results embracively with ample scope of parameters. Air-cored coils, coils with stranded conductors and laminated iron cores are treated. Then attention is given to self-capacitance, the Q-frequency relations, harmonic distortions and impedance measurements. A closing chapter works out six typical examples.

Sales Engineering. By Bernard Lester. Published by John Wiley & Sons, Inc. New York, 16. 226 pages. Price $3.00.

Rearrangement and amplification of material make this second edition (first 1940) more than ever the mentor for the well-versed engineer who "looks over the fence" and aspires to be a seller of engineering products and equipments. Specific examples of good and bad techniques illustrate the psychology so indispensable an adjunct to technical competency. Precepts are enunciated on every page.

Data and Circuits of Receiver and Amplifier Valves. Philips Gloeilampen Fabrieken. Obtainable from Elsevier Book Co. New York 3.

These Books II and III are sequels to the preceding volume on valve fundamentals. They give the typical handbook type of data for the valves issued from 1933-3a and 40 to 41. A subsequent Book IIIA will cover the 1945-49 period.

Lower Prices Coming. By William J. Baxter. Published by International Economic Research Bureau, New York 5, N. Y. 90 pages illustrated, Price $1.00

Mr. Baxter makes a good case for lower prices in the future by citing many excellent examples. His primary reasons are based on the ability of America to produce more than it consumes. Both agricultural and industrial production are estimated to gain by scientific developments to a point where government will lose control of prices. Since the city dweller's income has not kept pace with the farmers, Baxter believes that the balance must be restored.

In summary, the book presents a good case for a reversal of the inflationary trend of the American economy.

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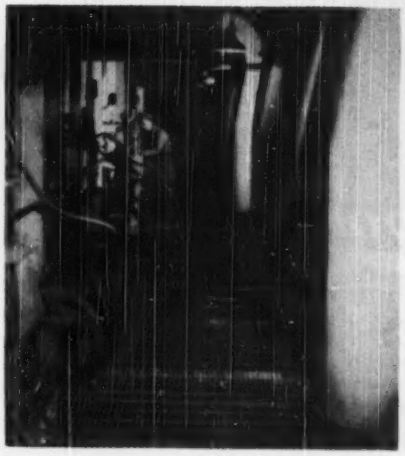

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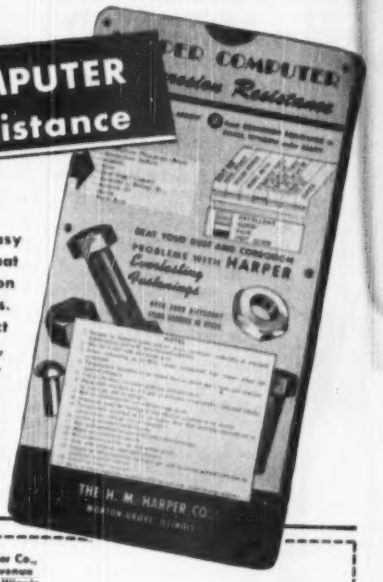

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AEROTEC

DUST COLLECTORS

. . . for the latest, most modern power plant

of the **AMERICAN GAS** *and*

ELECTRIC COMPANY

Hats off to the new Philip Sporn Plant at New Haven, West Virginia.

This completely integrated project has been designed to operate as one of the most efficient and economical power plants in the country. And the dust collecting system is an Aerotec Design 3-RAS, chosen for its high efficiency!

To date thirteen collectors for thirteen boilers have been purchased for the American Gas and Electric System. Many of these installations have been designed as split units, isolated for fan arrangement.

The photograph shows such a twin unit being erected on the roof of the Philip Sporn Plant, New Haven, West Virginia. This illustration is taken from the inlet side.

The Aerotec Design 3-RAS Mechanical Collector, composed of multiple, three-inch diameter, permanent molded aluminum tubes, is a highly efficient, light weight collector for the modern power plant. Efficiencies will meet the requirements of most dust ordinances today, and where higher efficiencies are required, the outlet provides a well distributed inlet for the Aerotec Electrical Precipitator . . . a Series combination that offers dust collection at its best.

Write for the new design 3-RAS Catalog No. 601.

Project and Sales Engineers

THE THERMIX CORPORATION

GREENWICH, CONN.

(Offices in 28 Principal Cities)

Canadian Affiliates: T. C. CHOWN LTD.,
1440 St. Catherine St., W., Montreal 25, Quebec,
50 Abell St., Toronto 3, Ontario

THE AEROTEC CORPORATION

GREENWICH, CONN.

SEARCHLIGHT SECTION

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(Not available for equipment advertising)

$1.20 a line, minimum 4 lines.
To figure advance payment count 5 average words as a line.
INDIVIDUAL EMPLOYMENT WANTED undisplayed advertising rate is one-half of above rate, payable in advance.
PROPOSALS, $1.20 a line an insertion.

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DISCOUNT of 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals.)

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The advertising rate is $9.75 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page.

E. W.

NEW ADVERTISEMENTS received by June 9th in the N. Y. office will appear in the June 19th issue subject to limitations of space available.

WANTED

GRADUATE ELECTRICAL ENGINEER

For design and development of instrument transformers. Two or more years experience necessary. Wattmeter meter experience desirable.

If satisfactory, position is permanent with future prospects excellent.

Our staff knows of this advertisement.

P-6513, Electrical World
330 W. 42nd St., New York 18, N. Y.

WANTED

EXPERIENCED ELECTRICAL ENGINEERS

Large Eastern Utility Company needs Electrical Engineers for permanent positions in rapidly expanding Transmission and Distribution design unit. Applicants must have experience in any or all of the following phases of work: Design of overhead and underground distribution systems; Study and layout of secondary network systems; Preparation of construction standards; Engineering check of sub-station design.

Applicants should apply by letter giving full details of education and experience. All replies considered confidential.

P-6515, Electrical World
330 West 42nd St., New York 18, N. Y.

ELECTRICAL DESIGN ENGINEERS

Opening for a few electrical design engineers who have had at least 5 years experience in Public Utility **Central Station** lighting and control wiring design. College graduates in electrical engineering preferred. Now considering applicants who will be available on or before July 1. Submit resume of experience, stating salary desired in first letter, to:

SALARY PERSONNEL MANAGER
Dravo Corporation Neville Island
Pittsburgh 25, Pennsylvania

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SPEEDY ASSEMBLY

Depends on parts, lines, wires, terminals, components properly marked or coded. Printed pressure-sensitive tape to quick, sure, easy, economical.

TOPFLIGHT TAPE COMPANY
YORK PENNA.

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (18)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

ELECTRIC WIRE sales engineer large Mid-West manufacturer has opening for Junior Sales Engineer. Candidate should be E. E. have table experience, either manufacturing or use. Be ready to assume senior responsibility and have preference for sales work. Plant location with travel. All applications confidential. Interview. P-6791, Electrical World.

EMPLOYMENT SERVICE

SALARIED POSITIONS $3,500-$25,000. If you are considering a new connection communicate with the undersigned. We offer the original personal employment service (40 years recognized standing and reputation). The procedure of highest ethical standards, is individualized to your personal requirements and develops overtures without initiative on your part. Your identity covered and present position protected. Send only name and address for details. R. W. Bixby, Inc., 262 Dun Bldg., Buffalo 2, N. Y.

POSITIONS WANTED

GRADUATE ELECTRICAL Engineer, 28, married, 5 yrs. electrical experience, 2 yrs. in distribution desires position with utility in mid-west or west. PW-6578, Electrical World.

EXECUTIVE ELECTRICAL Engineer — 30 years broad experience, administration, design, construction and maintenance; power plants, distribution and heavy industrial electrification. Available June 1st. Will consider temporary or permanent assignment. PW-6691, Electrical World.

SELLING OPPORTUNITY WANTED

ALLSTATE ELECTRIC Co., well established in Los Angeles, would like to represent reliable mfr. out here, or as distributor of staple electrical products. For particulars, references, write 653 Maple Ave., Los Angeles, Calif.

BUYERS OF SURPLUS COPPER INSULATED WIRES AND CABLES
No lengths too long or too short
Telephone: Eastgate 7-4778
PIERCE CABLE CO.
2670 Clybourne Ave. Chicago 14, Illinois

FOR SALE
STANDARD TRANSFORMERS
4—1000 KVA, 13,200/2400 Volts, 1 Ø, 60 Cycle, Subtractive Polarity 2-2½. Taps above and below. Two years in service. $2100.00, each F.O.B. 400 miles from Cullman.
CULLMAN POWER BOARD
Cullman, Alabama

1—DIESEL ELECTRIC GENERATOR
G.E. New Generator 950 KW 3 phase 60 cycle 480 Volts, 600 RPM, direct connected to Fairbanks-Morse OP 10 cylinder Diesel Engine and complete with auxiliaries and controls.
SUNDFELT EQUIPMENT CO., INC.
220 Hudson Street Seattle 8, Wn.

To

EMPLOYERS

who advertise

for MEN:

WHEN there are many applicants for a single position it frequently happens that the only letters acknowledged are those of the most promising candidates. Others may not receive any indication that their letters have even been received by a prospective employer much less given consideration. These men often become discouraged, will not respond to future advertisements, and sometimes question their bona fide character.

Every advertisement printed in the Searchlight Section is duly authorized.

It will help to keep our readers interested in this advertising if you will acknowledge every application received, even if you merely return the letters of unsuccessful applicants with, "Position filled, thank you" written or stamped on them. If you don't care to reveal your identity, mail them in plain envelopes.

We suggest this in a spirit of cooperation between employers and the men replying to Positions Vacant advertisements.

*

"Put yourself in the other fellow's place."

*

Classified Advertising Division

McGraw-Hill Publishing Co., Inc.

OPPORTUNITIES!

in

New and used equipment recently released from service by a number of electric and gas utility companies

POWER PLANT EQUIPMENT
CONSTRUCTION EQUIPMENT
SUBSTATION EQUIPMENT
TRANSMISSION LINE MATERIALS

Send for new list, . . . to

EBASCO SERVICES INCORPORATED
(APPARATUS EXCHANGE)
Two Rector St., New York 6, N. Y.

AMERICAN GENERATOR

125KVA, 3 phase, 60 cycle, 230-440 volt, 720 RPM, p. f. .8, with belt driven exciter. This unit is approximately three years old but has never been used. $1,750.00.

GENERATOR SET

Used Fairbanks-Morse 5 cylinder, 170 horsepower @770 RPM, with 125KVA Electric Machinery Generator—230-440 volt, 3 phase, 60-cycle. Skid mounted. Only 500 hours. $10,000.00.

Michigan Tractor & Machinery Co.
13801 Lyndon Ave. Detroit 27, Mich.
Phone: VErmont 7-5000

FOR SALE
NEARLY NEW
DIESEL GENERATOR PLANT

300 H.P., 440 V., 3 phase, 60 cycle, complete with Panel board, exciter, and fuel tanks. Atlas Diesel Engine. Installed during 1948 power shortage. Run only 2000 hours. Can be run and tested under full load in present position. Price—$20,000.00—purchaser to dismantle and ship. *Address:*

DOUGLASS LEWIS — Superintendent,
East Contra Costa Irrigation District,
Brentwood, Contra Costa County, California.

ELECTRICAL CABLE

- for every industrial and power application.
- Special constructions. Odd lengths.
- Large stocks on hand of high voltage, lead covered cables not ordinarily stocked by your regular supplier.
- Cut to length. Reasonably priced.

UNIVERSAL Wire and Cable Co.
2670 N. Clybourn Ave., Chicago 14, Ill.

FOR SALE
1 675 HP. Worthington Air Injection Diesel Engine.
1 480 HP. Busch-Sulzer Air Injection Diesel Engine.
Including all auxiliaries, motor, generators, etc.
Can be seen in operation any time.
Contact Mayor or City Clerk
Independence, Iowa

FROM AVAILABLE STOCK

TURBO GENERATORS

KW	Make	Desc.
750	G.E.	Condensing—250 lbs. I.S.P. 440 v. 3 ph. 60 cy.—Built 1944
500	Al. Ch.	Non Cond. 150 lbs. I.S.P. 5/10 lbs. B.P. 480 v 3 ph. 60 cy.
300	G.E.	Non-condensing 150/175 I.S.P. 5/10 B.P.—480 v. 3 ph. 60 cy.
400	Whse.	Non-condensing—125/180 lbs. I.S.P. 5/10 lbs. B.P.—440/480 v. 3 ph. 60 cy.

SYNCHRONOUS CONDENSERS

KVA	Make	Type	Volts	Speed
5140	Whse.			
4000	G.E.	TSC	2400/4150	600
2000	Whse.		2400/4150	900
			2400/4800	720

MOTOR GENERATOR SETS

3 ph. 60 cy.

KW	Make	Speed	DC Volts	AC Volts
1800	G.E.	600	125/250	2300/4150
1500	G.E.	360	275	2300/4600
1500	G.E.	600	600	2300/4150
1350	G.E.	600	275	4150
1000	Whse.	900	600	4150
1000	G.E.	720	250	2300/13200

TRANSFORMERS—60 Cycle

K	Make	Type	Ph	Voltages
3666	Whse.	OISC	1	66000x11000
2500	Al. Ch.	OISC	3	13200x2300
2500	Penn.	AT	3	13800x2300
1250	G.E.	HVDDJ	1	6600x330
1000	Penn.	OISC	1	13200/2300
600	Al. Ch.	OISC	3	2300/4150x230/460
333	Penn.	OISC	1	26400x2300

FREQUENCY CHANGERS

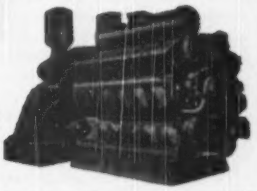
3000	KW	G.E.	25/60 cy. 2300/2300 v
500	KW	A. C.	25/60cy. 11000/2300v

BELYEA COMPANY, INC.

OFFICE & SHOP
51 Howell St., Jersey City 6, N. J.

DIESEL POWER

FOR
IMMEDIATE SHIPMENT
UNIT CAPACITIES—10 TO 1875 KVA
A.C.—50 AND 60 CYCLES
VARIOUS VOLTAGES



A PARTIAL LISTING OF OUR INVENTORY

KVA	Make	Model	HP	RPM	KVA	Make	Model	HP	RPM
1875	Fairbanks Morse	38F16	2600	300	375	Enterprise	DSG-6	450	450
1420	Fairbanks Morse	36D8¼	1900	720	500	Superior	KNA	500	514
1250	General Motors	16-278A	1600	720	312	General Motors	6-268A	450	1200
937.5	General Motors	12-567	1080	720	312	Clark	MD-4	375	327
625	Alco	6-12½x13T	750	600	187	Ingersoll Rand	8	225	514
425	Baldwin	VO-6	510	450	125	General Motors	3-268A	150	1200
400	Buckeye	80	480	600	75	General Motors	4043C	90	1200

D.C. UNITS ALSO AVAILABLE

A. G. SCHOONMAKER COMPANY, INC.
ENGINE DIVISION, 50 CHURCH ST., NEW YORK 7, N. Y.

J. L. HEMPHILL & CO.

ELECTRICAL ENGINEERS & EQUIPMENT

SLIP RING MOTORS

1—2500 HP G.E. MT 257 RPM 6600V
1— 500 HP G.E. MT 720 RPM 2200 V 4150

SYNCHRONOUS CONDENSER

1—2500 KVA Whse 720 RPM 2200 V with D.C. Exc.

MOTOR GENERATORS

1—1000 KW Whse 275 V 720 RPM 4150 Volt
1—1000 KW G.E. 600 V 514 RPM 2200/4000 V
1— 500 KW G.E. 275 V 900 RPM 4150 Volt
2— 150 KW G.E. 125/250 V 1200 RPM 4150 Volt

TRANSFORMERS

1—2500 KVA Amer. 3 Ph. 27,000V, 2300V.
2—1500 KVA G.E. 3 Ph. 27,000V, 2300V.
1—1500 KVA G.E. 3 Ph. 4150 V 2300 V Pyranol
1—1000 KVA G.E. 3 Ph. 4150 V 2400 V
1—1000 G.E. 3 Ph. 4150 2 Ph. 2400 V
1— 500 KVA Kuhlman 1 Ph. 4150 V, 2300 V
3— 400 KVA G.E. 6900 2300 V Sec.
1— 150 KVA G.E. 4150-240/480 V Pyranol
3— 75 KVA G. E. 2400-240/480 V
3— 75 KVA Whse 2300 230/115

Complete Line of A.C. and D.C. Motors and Generators

SEND your TRANSFORMERS to ELECTRIC SERVICE CO., INC.

A financially responsible organization specializing in buying, selling repairing, rewinding and redesigning transformers only.

Experienced personnel assures you first class workmanship and complete satisfaction.

Every transformer guaranteed for one year

The Electric Service Co., Inc.
"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
MARIEMONT Since 1912 CINCINNATI 27, OHIO

Co-op Electric Rates

To the Editor of ELECTRICAL WORLD:

The ELECTRICAL WORLD for April 17, 1950, under the department "The Electrical Week," indirectly quotes from my address to the 7th Annual Convention of the American Public Power Association on March 30, 1950, in Washington, D. C.

I am reported as having told the Association "that rural power rates in New York and New England were too high and going higher" and that I thereby "set a record for bad guessing" because "a few hours later Niagara Mohawk Power Corp. largest company in the area, announced a voluntary reduction in rural rates."

Specifically, what I said—in the third last paragraph of my address—was:

"One of the areas in which our REA cooperatives are having the most difficulty is the New England and New York State area. Here our cooperatives have suffered from spite line and other opposition tactics. They are too small and scattered to put in their own generation facilities. Their wholesale power cost is not only the highest in the country, but it is going up in contrast to the trend elsewhere in the Nation. These cooperatives are in the unfortunate position of having to buy their wholesale power from power companies which are competing with them at retail. There does not seem to be any competition between the wholesale power suppliers in this territory and, as a result power costs are the highest in the Nation. In my opinion, the urban centres of New England and New York State are suffering from the ill effects of this situation just as are the REA cooperatives. Perhaps it is not so apparent to them. Nevertheless, it is a real handicap to the economic well-being of that section of the country. . . ."

It can be seen that I was referring to the wholesale cost of power to REA-financed cooperatives and not to the rural retail rates of their power suppliers. As it so happens, the Niagara Mohawk Corp does not supply any of our borrowers with power, nor does it, to my knowledge, supply any rural distribution power system at wholesale.

I have no doubt that rural retail rates have been reduced in this area and that they can and may be reduced further. Thousands of farmers in the New York and New England area now enjoying electric service, who prior to the inauguration of the REA program in that area had been unable to obtain electric service at any cost or who had faced prohibitive connection and construction charges and other inordinately high charges, bear witness to the fact that retail power rates and charges have been reduced. These reductions have in some instances been made as part of the opposition tactics of commercial companies which sought to obstruct cooperative power development. But these retail rate reductions bear no relation to the subject matter of my address.

The facts which indisputably support my statement as correctly quoted above by me are shown in the attached table which lists for each year from 1941 through 1949 the average cost per kwhr of wholesale power purchased by REA-financed systems in this area as compared with the United States as a whole, and shows the amount of energy purchased each year. The table speaks eloquently for itself . . . .

Claude R. Wickard
Administrator
Rural Electrification Administration
Washington, D. C.

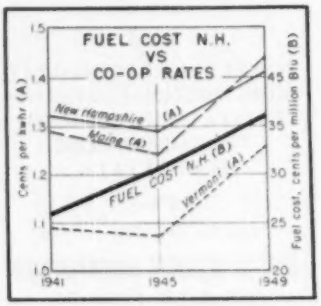
Average Cost Per Kwhr of Energy Purchased by REA-financed Systems at Wholesale from Private Power Company Suppliers (Year Ending June 30)

	1941	1945	1949
New York		1.33	1.38
		1,595	11,041
Maine	1.29	1.24	1.44
	330	1,094	3,523
New Hampshire	1.32	1.29	1.41
	403	2,602	6,041
Vermont	1.09	1.07	1.26
		2,803	10,901
U. S. Average	1.17*	1.01*	.96
	365,811	995,948	3,191,543
U. S. Average—all suppliers	1.00	.82	.89
	735,378	2,237,317	5,536,447

Notes
*Includes all private suppliers.
Figures under line represent Kwhr purchased (in thousands).
Years 1942-43-44-46-47-48 omitted due to space limitations—Editor

(Editors Note: The cost of fuel in 1948 for New Hampshire which is reflected in the 1949 rates was 43.8¢ per million Btu compared with the U. S. average of 22.3¢ per million Btu. It is interesting to note that in spite of the 100% difference in fuel cost, the rates were only 25% to 40% higher in New England than the U. S. average.

The following chart compares the cost of fuel in New Hampshire with energy rates to co-ops as supplied by Mr. Wickard.)



Hydro vs Steam Power

To the Editor of ELECTRICAL WORLD:

I noted with much interest your "Washington Comment" in the ELECTRICAL WORLD on April 10, 1950, about the Nebraska electric power muddle.

I recently prepared the attached tabulation showing that hydro power in Nebraska is not cheap as compared with fuel generated power.

If the hydros were required to pay interest on federal grants the difference in rates and monthly bills would be even more unfavorable to the hydros.

W. R. McGeachin
Contract Manager
Central Electric & Gas Co
Lincoln, Nebraska

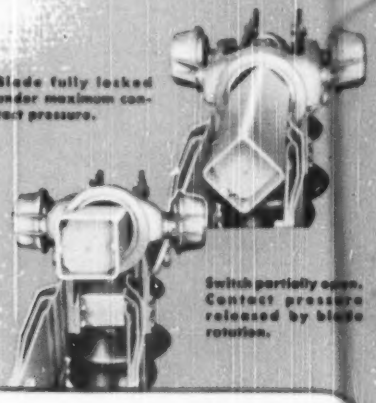
Comparison of Residence Electric Bills for 100 Kwhr Used Per Month in Twenty Nebraska Towns

Town	Population 1940	Cost of 100 Kwhr
Ten Towns Served with Electric Energy Supplied by the Nebraska Public Power Hydroelectric System		
Norfolk	10,490	$3.57
Kearney	9,643	3.57
York	5,383	3.73
Aurora	2,419	3.73
Columbus	7,632	3.73
McCook	6,212	4.20
Chadron	4,262	3.73
Valentine	2,188	4.18
Nelelgh	1,796	4.18
Scottsbluff	12,057	3.57
Average	**6,208**	**$3.82**
Ten Towns Having Municipal Electric Service and Using Coal, Fuel-Oil or Gas Exclusively, for Electric Generation		
Fremont	11,862	$2.64
Wahoo	2,648	3.92
West Point	2,510	3.23
Falls City	6,146	3.33
Hastings	15,145	2.70
Fairbury	6,304	3.35
Crete	3,038	4.10
Plainview	1,410	4.50
Alliance	3,360	3.80
Broken Bow	3,968	4.41
Average	**5,828**	**$3.60**

NOW A NEW IMPROVED "MK-40" IN RATINGS TO 4000 AMPERES

Profit by lower installation and maintenance costs plus improved electrical and thermal characteristics when you install these modern high capacity, group operated switches. Available in ratings up to 4000 amperes; 7.5 to 69-kv inclusive; for horizontal upright, vertical or underhung mounting positions. For full information ask for Publication 4904—Just out!

High capacity "MK-40" for 23-kv, 4000-amperes.



Blade fully locked under maximum contact pressure.

Switch partially open. Contact pressure released by blade rotation.

Here's why the "MK-40" is winning the acclaim of engineers

NOW —a new arrangement of contact shoes permits uniform contact pressure and increased thermal conductivity. Rolled silver inlays at points of contact reduce contact resistance and abrasion to a minimum. Hard drawn copper current carrying parts are arranged in a straight line current path from terminal-to-terminal.

NOW —a powerful blade actuating mechanism, employing only three moving parts, opens and closes the blade smoothly without stops, shunts, cranks or auxiliary devices. Blade is locked automatically in fully opened or closed positions.

NOW —greaseless, non-rusting ball bearings on all essential rotating parts. Threadless pipe fittings thruout operating mechanism facilitates rapid switch alignment. Adjustment remains permanent.

WHEN YOU WANT THE BEST IN HIGH VOLTAGE SWITCHES SPECIFY "MK-40"

DELTA-STAR ELECTRIC COMPANY

MAIN OFFICE AND FACTORY — 2400 Block, Fulton St., Chicago 12, Ill.
NEW YORK OFFICE — 140 Cedar St., New York 6, N. Y.

DISTRICT REPRESENTATIVES IN THE FOLLOWING CITIES

Birmingham, Ala.
Boston, Mass.
Buffalo, N. Y.
Charlotte, N. C.
Cleveland, Ohio
Dallas, Texas
Denver, Colo.
Detroit, Mich.
Indianapolis, Ind.
Jacksonville, Fla.
Kansas City, Mo.
Knoxville, Tenn.
Los Angeles, Cal.
Minneapolis, Minn.
Norfolk, Neb.
Norfolk, Va.
Philadelphia, Pa.
Pittsburgh, Pa.
Richmond, Va.
Roanoke, Va.
St. Louis, Mo.
San Francisco, Cal.
Seattle, Wash.
Tampa, Fla.
Washington, D. C.
Honolulu, Hawaii

CANADIAN ASSOCIATE
Canadian Line Materials Limited — Toronto 13, Canada

CASE STUDY

Annual Savings in Turbine Lubricating Costs with Nonpareil Turbine Oil in a Midwest utility.

Turbine ..... 35,000 KW, 1800 RPM
Oil System Capacity .... 2800 gallons
Operation ... 1931 to 1937 on Turbine Oil X at 45¢ per gallon
Operation ... 1938 to 1948 on Nonpareil Turbine Oil at 87¢ per gallon
Annual Cost of Lubrication with Turbine Oil X ..... $ 911.57*
Annual Cost of Lubrication with Nonpareil Turbine Oil ... $ 284.13*
Annual Saving 68.8%

CASE STUDY

Annual Savings in Turbine Lubricating Costs with Nonpareil Turbine Oil on a large utility turbine.

Turbine ..... 80,000 KW, 1800 RPM
Oil System Capacity .... 8,000 gallons
Operation ... Dec. 1935 to April 1942, on Turbine Oil Y at 39¢ per gallon
Operation ... May 1942 to Jan. 1948 on Nonpareil Turbine Oil at 88¢ per gallon
Annual Cost of Turbine Lubrication with Turbine Oil Y .... $ 575.30*
Annual Cost of Lubrication with Nonpareil Turbine Oil .... $ 503.93*
Annual Saving 12.4%

CASE STUDY

Annual Savings in Turbine Lubricating Costs with Nonpareil Turbine Oil in a Midwest utility system.

Turbine ..... 20,000 KW (Now 30 years old)
Oil System Capacity .... 550 gallons
Operation ... June 1940 to Aug 1944, on Turbine Oil Z at 55¢ per gallon
Operation ... Oct 1944 to Oct 1948 on Nonpareil Turbine Oil at 89½¢ per gallon
Annual Cost of Lubrication with Turbine Oil Z ..... $ 83.90*
Annual Cost of Lubrication with Nonpareil Turbine Oil .... $ 69.49*
Annual Saving 17.2%

*Includes (1) cost of original fill—including interest charges, (2) oil replacements, (3) oil treating or sweetening, (4) cleaning turbine oil systems, (5) filter maintenance (where these items apply).

Turbine lubrication costs CUT... up to 68%

NONPAREIL Turbine Oil

STUDIES have been made of typical utility company operations to determine how much the *price* of turbine oil affects the *cost* of turbine operation. Three such studies are summarized here. In each case, the price of the original fill of oil was 38% to 55% *less* than that for Nonpareil. But in each case the total annual cost for lubrication, when all factors are considered, shows a saving with Nonpareil.

You can find out how much Nonpareil will save on your lubricating costs. Standard Oil Lubrication Engineers have facts and figures to help you determine costs of Nonpareil lubrication for comparison with your present costs.

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, to secure the services of the Engineer nearest you.

STANDARD OIL COMPANY (INDIANA) STANDARD